VECTOR

OPERATIONS MANUAL

E-ONE

SPARTAN

VECTOR
CAT. VEC-CHA-PMP-EV-2602
February 2026

E-ONE, Inc. and Spartan Fire, LLC

Operation and Service Manual

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Brand names may be used in this manual to clarify illustrations or descriptions.

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SERVICE AND SUPPORT

OBTAINING CUSTOMER SERVICE

Customer service and support for Vector fire apparatus is handled through E-One Inc. in Ocala, Fl.

Most questions regarding operation or service should be addressed to your apparatus dealer organization. If you are unable to obtain satisfactory assistance, or if your questions remain unanswered, please contact customer service at:

Email: **wclaims@e-one.com**

Telephone: **Business Hours 7:00 am to 6:00 pm eastern time:** **352-237-1122**
Outside of Business Hours, Including Weekends: **352-804-3143**

Ground: **E-ONE Customer & Product Support**
1601 SW 37th Avenue
Ocala, FL 34474

VEHICLE IDENTIFICATION NUMBER

When filing a warranty claim, submitting a complaint, or general inquiries, you will need to provide the last eight digits of the vehicle identification number (VIN) as stated on the label.

EMISSIONS WARRANTY

Engine emissions and aftertreatment systems are warranted by the engine manufacturer for five (5) years or 100,000 miles (160,934 km). (see your engine emissions warranty for details).
In conformance with 40CFR§1037.120 your custom chassis apparatus is warranted to the ultimate purchaser and each subsequent purchaser as follows:

- The tires delivered with this new vehicle will be free from defects in materials and workmanship that cause the vehicle to fail to conform to the requirements of 40CFR§1037 Control of Emissions from New Heavy-Duty Motor Vehicles for two (2) years or 24,000 miles (38,624 km).
- Engine emissions related components and air conditioning refrigerant sealing components will be free from defects in materials and workmanship that cause the vehicle to fail to conform to the requirements of 40CFR§1037 for five (5) years or 100,000 miles (160,934 km) (see your apparatus emissions warranty for details).

MAINTENANCE RECORDS

It is the owner's responsibility to keep accurate maintenance and repair records, including receipts.
Should the lack of required maintenance be the reason for repair, a warranty claim will not be accepted.
E-One reserves the right to request your maintenance and repair records for verification of compliance with required maintenance practices and intervals.

E-One recommends maintenance and repair records/receipts be maintained as permanent records and kept in a secure location. Acceptable records include itemized bills, dealer work orders, owner's vehicle log, and service facility receipts, which must state the date service was performed Vehicle Identification Number (VIN), mileage (kilometers), engine hours, and service performed.

NOTICE

Throughout this manual the term "routinely" is used to describe certain maintenance intervals. Rou- tine maintenance interval may be dependent on vehicle usage, for such recommended activities the user shall define intervals.

E-One recommends referencing: **NFPA® 1910** *Standard for the Inspection, Maintenance, Refurbishment, Testing, and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels* for completed apparatus maintenance recommendations.

USE OEM PARTS FOR REPAIR

Your aerial device is designed to operate as a system. Every part has been selected to ensure proper performance. Use of repair parts other than those provided by your E-One authorized repair facility will void warranty. Use only E-One OEM parts for service or repair.

REPORTING AN ACCIDENT

Notify E-ONE any time your apparatus is involved in an accident resulting in personal injury or death. The company will investigate all such incidents. Never remove, damage, or modify any part of your apparatus that is involved in an accident investigation.

Customer Service must be notified whenever the Side Roll Protection System or Frontal Occupant Protection System has been activated. DO NOT remove or tamper with any Side Roll Protection System or Frontal Occupant Protection System components, except to extricate the occupants.

SAFETY DEFECT REPORTING

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying E-ONE. If NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or E-ONE.

To contact NHTSA, you may call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153); go to http://www.safercar.gov; or write to: Administrator, NHTSA, 400 Seventh Street, SW., Washington, DC 20590. You can also obtain other information about motor vehicle safety from http://www.safercar.gov.

To contact EPA, address concerns to:
Director Field Operations and Support Division
Environmental Protection Agency
401 M St. SW., Washington, DC 20460

SAFETY

INTRODUCTION

Operator Manuals

This operation and service manual is one in a set of manuals that instructs you on how to properly and safely operate an apparatus. For a complete understanding of the safe and proper operation of your apparatus you must read, study, understand, and follow the information found in each of the manuals provided to you. These many include the following:

- Custom Chassis
- Commercial Chassis
- Aerial Device
- Pumping System

These manuals do not replace, nor does their use absolve you from complying with any and all applicable Federal, State, or Provincial regulations, safety codes, operating limitations, fire company procedures or insurance requirements.

Major Component Manuals

Additional safety, operation, and service information is located in the associated major component operation and service manuals. Study the safety information found in all the manuals provided including manuals for the engine, transmission, pump, breathing air system, foam system, generator, and others included in the information provided with the delivery of your apparatus.

Industry Standards and guidelines.

There are many industry standards and guides that you and your department must follow to safely operate your apparatus including those shown here.

- **NFPA® 1900** *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire apparatus, Wild- land Fire Apparatus, and Automotive Ambulances*
- **NFPA® 1910** *Standard for the Inspection, Maintenance, Refurbishment, Testing, and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels*
- **NFPA® 1451** *Standard for a Fire and Emergency Service Vehicle Operations Training Program*
- **NFPA® 1500** *Standard on Fire Department Occupational Safety, Health, and Wellness Program*
- **NFPA® 1962** *Standard for the Care, Use, Inspection, Service Testing and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*
- **IFSTA** *Pumping and Aerial Apparatus Driver/Operator Handbook*
- **FAMA** *Fire Apparatus Safety Guide* (additional copies available from FAMA.org)
- **FEMA** *Safe Operation of Fire Tankers* (downloadable from FEMA.org)
- **PSHSA** *Electrical Safety Handbook for Emergency Responders* (Public Services Health and Safety Association of Canada, www.pshsa.ca)

Apparatus Modifications

Modification of this apparatus from its original design without written permission from the manufacturer is strictly prohibited and may result in subjecting personnel to a risk of injury or death. The manufacturer reserves the right to change, improve, modify or expand features of its products at any time, without notice, and without incurring any obligations to change, improve, modify or expand features of previously delivered equipment.

Safety Alerts

The safety signs found on your apparatus and in this manual use the ANSI Z535 safety alert symbol system. You should be familiar with this system and understand the meaning of each symbol.

Safety Alert Symbol

The Safety Alert Symbol means: “ATTENTION! STAY ALERT! YOUR SAFETY IS INVOLVED!”

The Safety Alert Symbol identifies important safety messages on your apparatus, on your equipment, on safety signs, in manuals or elsewhere. When you see this symbol, be alert to the possibility of death or personal injury. Follow instructions in the safety message.

Signal Words

Signal words are intended to alert you of a potential hazard, the general severity of the hazard and that a message will follow which will provide instruction on how to avoid the hazard.

Danger: Indicates a hazardous situation which, if not avoided, WILL result in death or serious injury.

Warning: Indicates a hazardous situation which, if not avoided, MAY result in death or serious injury.

Caution: (without safety alert symbol) Indicates a situation which, if not avoided may cause equipment damage.

Extrication and Air Bags

Your apparatus may be equipped with occupant roll-over or front crash protection airbags and other pyrotechnic devices that may deploy during a rollover or frontal crash.

In case it is necessary to perform the extrication of an occupant of this vehicle, performing any one of the following will disable the roll or frontal sensors and any unfired protective devices:

- Turn battery master switch to the OFF position, OR
- Move ignition switch to the OFF position, OR
- Disconnect the batteries, OR

- Cut the wires to the protective device actuators.

Fired protective devices pose no toxic threat to rescue personnel. After a side roll accident, the seat belts on all the occupants will be tight, but have specially designed buckles that can be released under belt tension. Use extreme care when releasing seat belt buckles and exiting a damaged vehicle. The bags will be filled with warm inert gases. The gases will be nearly invisible, but will have an acrid smell. The gases pose no harm to occupants or rescue personnel.

Vehicle Data Recorder

Your NFPA® 1900 compliant apparatus may include a Vehicle Data Recorder (VDR). This device allows you to download data from your apparatus that will tell you certain safe driving information such as whether your apparatus is driving too fast, stopping too quickly, or being operated with unbelted occupants. The intention of this device is to assist you in monitoring, training, and enforcing safe apparatus driving practices. Download and use this data regularly to ensure that the personnel under your supervision are operating safely.

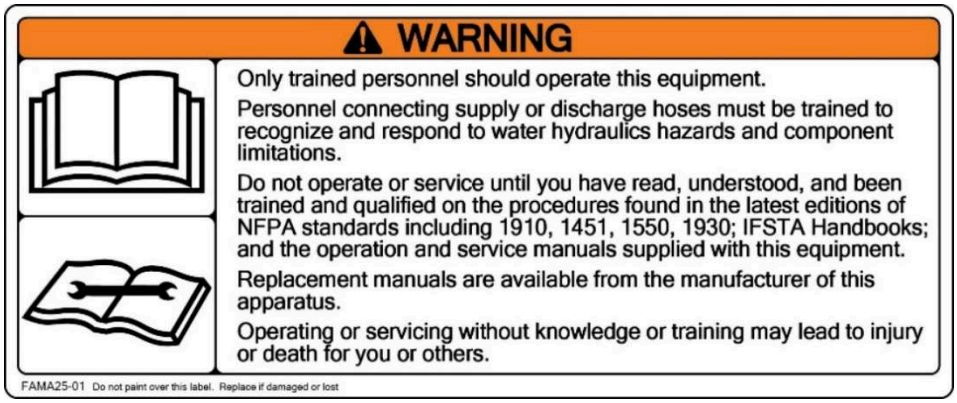
TO THE APPARATUS USERS

To the Apparatus Driver/Operator

A custom fire apparatus is not a consumer product; it is a complex piece of industrial equipment. It has the potential to harm you or those around you if you use it improperly. Safe operation requires you to be trained, be experienced, be smart and use your common sense. It is essential that you be careful, physically and mentally qualified, trained in the safe operation of this equipment, and authorized by your fire department to do so. Never work on or around a fire apparatus, or operate it, unless you have:

- Read and understood this operation and service manual.
- Watched and understood any safety video(s).
- Read and understood any other operation and service manuals associated with your apparatus.
- Read and understood the operation manual(s) of components supplied with this apparatus.
- Read and understood the FAMA Fire Apparatus Safety Guide.
- Read and understood all safety signs posted on your apparatus.
- Been trained in the safe operation of this apparatus in accordance with NFPA 1451 Standard for a Fire and Emergency Service
- Been properly trained and are authorized to operate your apparatus.

If you do not feel comfortable with your knowledge, training, level of experience or the adequacy of your personal protective equipment, stop what you are doing and report this to your supervisor. If you feel that the apparatus is not functioning safely, stop what you are doing, report it to your fire department safety officer or fire chief, and do not use the apparatus until the hazardous situation can be resolved.



To the Apparatus Mechanic

Fire apparatus are complex machines made of thousands of parts. As with all machines, they must be constantly maintained and can break down. The safety of the firefighters using your apparatus, as well as the safety of people in your community, depend on frequent and thorough inspection, service and maintenance of your apparatus and its associated equipment. Since you will probably need to operate your apparatus in the course of servicing it, you must be intimately familiar with safe methods of operation as well as safe maintenance practices.

If you do not feel comfortable with your knowledge, training, level of experience or adequacy of your personal protective equipment, stop what you are doing and report this to your supervisor. If you feel that the apparatus is not functioning safely, stop what you are doing, report it to your fire department safety officer or fire chief, and do not use the apparatus until the hazardous situation can be resolved.
Never attempt to service or maintain a fire apparatus unless you have:

- Read and understood the FAMA Fire Apparatus Safety Guide.
- Watched and understood any applicable safety video(s).
- Read and understood this operation and maintenance manual(s).
- Read and understood the operation and maintenance manual(s) of components supplied with your apparatus.
- Been properly trained and are authorized to maintain and operate your apparatus.

To the Safety Officer

NFPA 1521 *Standard for Fire Department Safety Officer* establishes specific and essential responsibilities for your role relating to the safe operation of fire apparatus in your department. You are expected to participate in the specification of new apparatus to ensure that the apparatus will include safe features consistent with the way your department will operate. You are also expected to monitor your apparatus while it is being used to make sure that the firefighters using your apparatus are doing so in a safe manner.

The highly custom nature of fire apparatus makes your role and responsibilities extremely important. Fire department operations vary greatly and we cannot anticipate all the potential ways your apparatus may be used. It is your responsibility to make sure the ways your department operates are consistent with the instructions in this manual. Where a custom feature is not covered, it is your responsibility to make sure safe practices are established and followed. It is essential that you anticipate the way your department personnel will use your apparatus and how it is actually being used once it is placed in service. A custom feature, or a common feature installed in an uncommon fashion, may present a hazard that was not apparent at the time of manufacture. If you observe anything that you feel is unsafe, it is your responsibility as established by NFPA 1521 to address it. Contact us if you need help and we will work with you to ensure that your apparatus is safe in every regard.

To the Training Officer

NFPA 1451 *Standard for a Fire and Emergency Service Vehicle Operations Training Program* establishes specific and essential responsibilities for training in the safe operation of fire apparatus in your department. Personnel must never be allowed to operate an apparatus unless you are convinced that they have been thoroughly trained in its safe operation, and they are experienced enough to operate safely all the time without supervision. They must be trained to operate safely all the time, not cut corners, not operate the apparatus in ways it was not intended, and not be careless with the safety of themselves or others. NFPA 1451, Annex B offers a detailed checklist of potential hazards found on apparatus that every operator must be trained to avoid.

To the Fire Chief

As with any piece of complex industrial equipment, your apparatus is designed to be operated only by trained, experienced and sophisticated users. Many fire chiefs have had to deal with tragic outcomes when apparatus have been placed in the hands of poorly trained, inexperienced or undisciplined personnel. Such mistakes can result in injury or death to firefighters, the victims you are intending to rescue or innocent bystanders. It is essential that you support your safety and training officers, foster a culture that promotes safe operation and provide consequences for those who choose not to follow the rules.

GENERAL SAFETY

Parades and Public Events

Your apparatus is designed for personnel to be transported only while wearing seatbelts. Transporting people who are not seated and belted should never be allowed. Before using your apparatus in parades, educational demonstrations, charitable fundraisers, or other community events where untrained people will be in, on, or around your apparatus you must create a safety plan that will protect them from harm. Before allowing anyone other than a trained and experienced member of your department near your apparatus, you should consult with your fire department safety officer and plan for safety. Be sure to follow all the safety procedures in this manual, and ensure that the event will be conducted in a manner that is safe for everyone involved.

Not Designed for Children

Your apparatus is designed for adult fire fighters and is not suitable for the transportation of children. Your apparatus is compliant to the Federal Motor Vehicle Safety Standards that apply to trucks over 10,000 lbs. These standards expect that operators are adult professions and they do not account for the needs of children. Features including the following may not be appropriate for accommodating children or people of extremely small stature.

- SCBA Seating
- Seat Belt Accommodations
- Inflatable Occupant Restraints
- Power Window Controls
- Child Seat Attachments

Vehicle Data Recorder

Your NFPA 1900 compliant apparatus may include a Vehicle Data Recorder (VDR). This device allows you to download data from your apparatus that will tell you certain safe driving information such as whether your apparatus is driving too fast, stopping too quickly, or being operated with unbelted occupants. The intention of this device is to assist you in monitoring, training, and enforcing safe apparatus driving practices. Download and use this data regularly to ensure that the personnel under your supervision are operating safely.

Follow a Safety Program

Turnout gear is important any time you are operating on or around your apparatus. Your fire apparatus is heavy equipment, and PPE is appropriate any time you are using it.
You may need:

- Boots.
- Helmet.

- Heavy-duty gloves.
- Reflective clothing.
- Hearing protection.
- Safety glasses, goggles or face shield.

Always Be Alert

As a first responder you are trained to be situationally aware. This means you are always looking out for what is around you even in the midst of an emergency. This awareness is just as important during mop-up, training, testing, cleaning, service, maintenance or any other time you are working in, on or around your apparatus. Don't be tempted to forget the importance of being aware and alert when there is no emergency. Many injuries occur during routine operations when your guard is down. You may be tempted to relax around the apparatus when performing tasks you have done many times before. Avoid this temptation. Your equipment must be respected at all times for your safety and the safety of those around you.

Be Careful

Mistakes are more likely when you are tired, distracted, or overwhelmed. Call in extra assistance and let someone else take over if you become fatigued or ill. Never operate on or around your apparatus under the influence of drugs or alcohol. Operating your apparatus in an un-well condition can lead to death or injury for you or others.

Know the Rules

Your department will have rules and procedures to keep you safe. These must include the instructions in this manual. Know the rules and follow them. If you find a conflict in the rules work with your department's safety officer to resolve the conflict.

Commercial Driver's License Course

Your state may exempt you as a firefighter from the requirement to hold a commercial driver's license (CDL), but the rig you are driving may be bigger and heavier than most other trucks on the road. Commercial drivers must learn the right way to inspect and operate heavy trucks and demonstrate their abilities before they are issued a license. Consider taking these courses and obtaining your CDL even if not required to do so by your department. You will learn valuable safety tips, demonstrate your skills and feel more confident behind the wheel of your apparatus.

Practice Safe Practices

It is not enough to simply be instructed on safe apparatus operation. Consistently safe operation happens because you know how to operate safely and have practiced safe operation long enough to establish safe habits that are committed to both your mental memory and your muscle memory. Never cut corners in safety during practice sessions to avoid unintentionally cutting corners during an emergency.

Safety Signs

Read and understand all the safety signs on your apparatus before you operate the equipment. They communicate the most critical safety messages, but they are meant to remind only. You should know, memorize, and follow the instructions without needing to read them during operation.

Operate Only What You Know

Your apparatus may have unique characteristics or features that were custom ordered by your department. Other apparatus in your fleet may have different unique characteristics or features. Only operate an apparatus that you are completely familiar with and that you have been trained and authorized to use safely.

Operate Only Well Inspected Apparatus

Your apparatus must be in excellent working order at all times if you are going to ensure your own safety and the safety of others.

Follow the **NFPA 1910** *Standard for the Inspection, Maintenance, Refurbishment, Testing, and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels* and your manufacturer's operation and service manuals to keep your apparatus safe for operation. These publications will tell you what to check, what to test, how often they need to be checked or tested, and when you should remove your apparatus from service. Your apparatus should be inspected thoroughly on a regular basis. Study the inspection criteria found in this manual, the other applicable operator manuals, the decals and markings on the apparatus itself, and your State's commercial driver's license pre-trip inspection requirements. Determine how each requirement will apply to your apparatus and consolidate this data into a single pre-trip or start-of-shift inspection. Determine when and by whom the inspections will be performed, make sure these individuals are trained and qualified to perform the inspections, and establish a regular inspection schedule. Make sure you perform each inspection in teams of two, with one person operating interior controls while the second person is checking for exterior functions such as turn signal lamps, flashers, brake lights, etc.

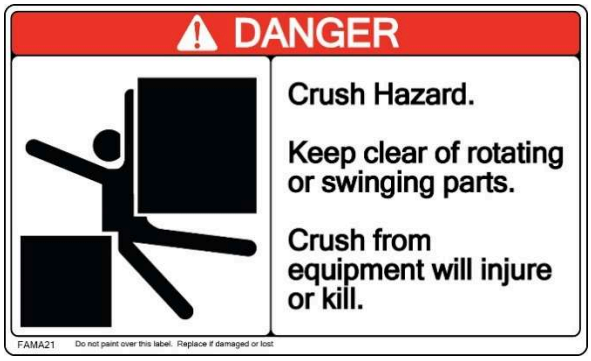
Record all deficiencies in compliance with **NFPA 1910** *Standard for the Inspection, Maintenance, Refurbishment, Testing, and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels*. Review the previous inspection report at the start of each shift to ensure that any deficiency that was noted by the previous crew has been resolved.

GENERAL HAZARD IDENTIFICATION

Your apparatus will have safety signs warning of the more common hazards, but not every hazard will be identified with a safety sign. You must use your common sense. Look for and avoid these general hazards. Study your apparatus to identify each hazard and develop methods of avoiding each. It is best to make this a written plan so that you can share it with all the personnel who may be working on or around your apparatus.

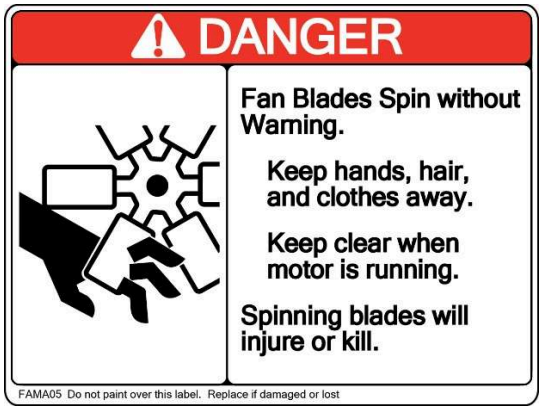
Pinch and Crush Hazards

Look for places where there are moving parts such as folding steps, aerial ladders, rollout shelves, aerial turntables, stabilizers, cab and compartment doors, etc.



Rotating Parts Hazards

Common rotating parts include; drive shafts, power take-off shafts, cooling fans, compressors, generators and hose or cord reel drives. Do not wear loose clothing or other items that could get tangled in the shafts or fans. Many rotating parts can begin to spin without warning; therefore, treat each hazard as if it were spinning already.

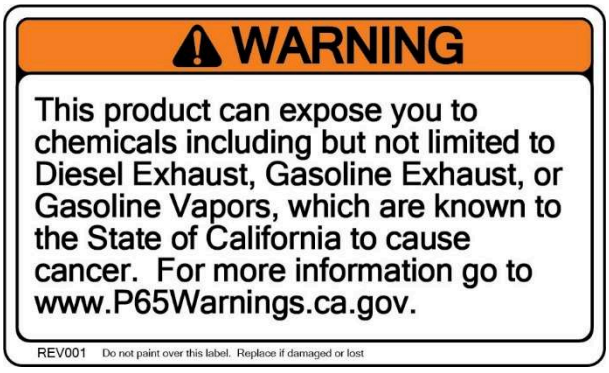


Hot Parts Hazards

Common hot parts include; engine, exhaust, air compressors, water pumps, air conditioning compressors, foam pumps, line voltage generators, and fuel-fired heaters. Diesel engines equipped with diesel particulate filters require regeneration that involves high heat. The exhaust system can get extremely hot without warning. Keep away from exhaust gas and do not park your apparatus where the exhaust pipe points toward or near flammable material.

Exhaust Fumes

Internal combustion engines give off hazardous fumes while running. Never run your apparatus engine inside a building unless the exhaust discharge is connected to an extraction system. Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm. Do not operate any internal combustion engine in an area where exhaust gases can accumulate or serious injury or death may occur. If exhaust fumes are suspected of entering the vehicle cab, rectify the defect immediately. Do not perform a DPF regeneration inside a building. Do not stay inside your parked apparatus cab for extended periods of time with the engine running as exhaust fumes could seep into the cab causing illness or death.



Chemical Exposure

Your apparatus could expose you to chemicals that the State of California has determined can cause cancer. Avoid exposure to these chemicals including Diesel Exhaust, Gasoline Exhaust, and Gasoline Vapors. Check with the California website to learn more at https://oehha.ca.gov/proposition-65/chemicals.

Fire

Your apparatus is composed of many parts that can catch on fire. These include fuel, oils, plastics, rubber, vinyl and cloth. It also has a source of ignition in the form of batteries and electrical wiring. Chaffed wires can cause heat or sparks that can start a fire. Avoid parking your apparatus, or any other motor vehicle, inside any structure that has common walls with a sleeping area. Install fire alarms and sprinklers in garage bays. Make sure that your apparatus is well maintained and that hot components and wire harnesses are kept free of grease, oils and other contaminants. Clean all build-up of oily or greasy dirt that can burn and spread a vehicle fire quickly.

If your apparatus catches on fire while driving:

- Bring vehicle to a complete stop as quickly as possible
- Apply parking brake
- Shut down engine
- Turn off master power switch
- Leave vehicle.

Electrical Shock

Your apparatus may be equipped with line voltage capability (120 V, 240 V, etc.). Common sources of line voltage include invertors, gas or diesel generators, generators driven by power-take-off shafts from the main engine, or hydraulically powered generators. You will also have line voltage on board while you have your apparatus plugged in to shore power.

Noise

Your apparatus may be equipped with audible warning devices that create loud noise to clear traffic. There may be local and state laws in your area governing the use of such devices. Use the city horn instead of the air horns and sirens unless needed. Sirens produce loud sounds that may damage hearing:

- Roll-up windows
- Wear hearing protection
- Use only for emergency response
- Avoid exposure to siren sound

Do not operate sirens or air horns with personnel standing in the immediate vicinity (within 50 feet) of the front of your apparatus.

Always use hearing protection such as ear plugs, muffs, or noise canceling intercom headsets to keep your noise exposure within the following NIOSH recommended limits.

Duration of Exposure per Day (Hours)	TWA A-weighted SPL (dB)
8	85
4	88
2	91
1	94
1/2	97
1/4	100
1/8 (7 min. 30 sec.)	103
1/16 (3 min. 45 sec.)	106
1/32 (1 min. 53 sec.)	109

NIOSH Recommended Noise Levels

Establish a departmental hearing conservation program to monitor the hearing levels of fire department personnel in accordance with the guidelines found in *NFPA 1500 Standard on Fire Department Occupational Safety, Health and Wellness Program*.

Your apparatus is equipped with noise suppression components as part of the engine emissions system and powertrain. Do not remove or disable noise suppression components for any purpose other than maintenance, repair, or replacement.

Undercarriage

Use special caution if you need to be underneath your apparatus for any reason. The bottom of your apparatus is not designed to be an operational area, and there are many hazards you will encounter including rotating drivelines, PTO shafts, hot exhaust, pumps, and components which may emit hot steam or chemicals. Inform others and use lock-out tag-out procedures before working beneath your apparatus.

UNDERSTANDING YOUR OPERATING ENVIRONMENT

Know Your Response Area

Your apparatus is higher, heavier, longer, and wider than many other vehicles on the road. State and Federal regulations allow fire apparatus to have higher axle weights than other commercial vehicles. These factors mean that you need to be more careful that other vehicles about where you can safely operate.
Drive your streets in your apparatus and plan your routes around the size, weight, and capability of your apparatus. Note any areas where your apparatus should not be driven. Plan response routes to cover your district while avoiding these hazards.
Pay special attention to the following:

- Road weight limits
- Bridge weight limits
- Low overhead wires

- Low trestles, bridges, and under-passes
- Low traffic signals
- Railroad crossings
- Cul du sacs, dead ends, and turn-arounds
- Narrow roads and alleyways
- Narrow roads with steep drop-offs or soft shoulders

Know Your Climate

Like any other machine, fire apparatus may require special consideration in inclement weather. High winds, freezing rain, flooding, snow, ice, as well as extreme heat or cold, can all present special challenges to safe operation. Think about the types of extreme weather common to your area and make a list of the special hazards these may present. You will find many weather related precautions throughout this manual. Identify special procedures to counter extreme conditions and practice them while in good weather so that you know what to do when nature turns against you.

Know the Rules of the Road

Your local laws may allow you more road privileges than the general public, but they do not change the laws of physics. You must know the limitations of your apparatus, respect these limitations and drive defensively at all times. Your apparatus is a heavy vehicle that will take more time to accelerate, more distance to stop and is less stable in turns than your passenger vehicle. Heavy axle weights will make it more likely that if you wander onto a soft shoulder you will be drawn off the road and into a ditch. Always drive your apparatus safely and deliberately. The few extra minutes you save running the red light or driving fast through the curves will be lost if you don't arrive safely.

Check the operation of your lights and sirens prior to the start of each shift. Do not rely on your audible and visual warnings to clear the right of way. People may not hear, see or heed your warning signal. You must recognize this fact and continue driving cautiously.

Traffic Signal Capturing

Your apparatus may include a system that works with your local traffic control signals to increase the potential that you will always get a green light at a controlled intersection. While such systems are useful to improve your response time, they are not foolproof. Like any mechanical or electrical system they are susceptible to failure. It is also possible that your apparatus gets pre-empted by another emergency vehicle with a higher priority. You should, therefore, never assume that you will get a green light. Always obey traffic signals.

SECURING EQUIPMENT

Secure Interior Equipment

If your apparatus crashes it will stop quickly, but items inside the cab will keep going at the speed the apparatus was traveling prior to the crash. Only store items in a cab that can be secured in compartments or in strong brackets. The compartment or bracket should be able to hold the item even if you pull on it with a force equal to nine times its weight.

Secure Exterior Equipment

Ground ladders or other equipment that falls off your apparatus can injure or kill drivers or pedestrians in your path. Make sure that every compartment door is closed and secured and every piece of equipment is locked in its bracket before you drive away. Inspect compartment door hardware and equipment brackets regularly to make sure your equipment stays on the apparatus where it belongs.

Restrain Hose

Your apparatus includes a hose restraining method for all your designated hose storage areas. Hose that falls off your apparatus can injure or kill drivers or pedestrians in your path. Never drive your apparatus without the hose restrains securely in place.

WORKING AROUND YOUR APPARATUS

Slips, trips and falls are one of the most common ways of being injured when working around your apparatus.

Avoid Climbing and Walking on Top

Avoid the need to climb on your apparatus by locating items you need to access during emergency operations in compartments that can be reached from the ground. Store equipment above ground level only that you can access in the station or other controlled environment where you can use safety ladders, lifts, or use fall protection equipment to retrieve them.

Clean from the Ground

Perform routine windshield, cab glass, and mirror surfaces from the ground using brushes and squeegees mounted on extension poles. When better access is necessary for washing the entire apparatus use platforms, safety ladders or other means to avoid climbing on wet slippery surfaces.

Use Three Points of Contact

Three points of contact means you have one hand and two feet, or two hands and one foot in contact with the vehicle at all times. If you can't find sturdy features to provide three points of contact, have the vehicle modified or repaired.

When climbing, it is very difficult to maintain three points of contact without facing the vehicle. Always face your apparatus when getting on and off. Backing out is much safer.

Clean and Repair

Keep steps, walking surfaces, hand rails and shoes free of grease, mud, dirt, fuel, ice and snow. Inspect your apparatus steps, walking surfaces, and handrails frequently. If defects are found remove the apparatus from service until repairs can be made.

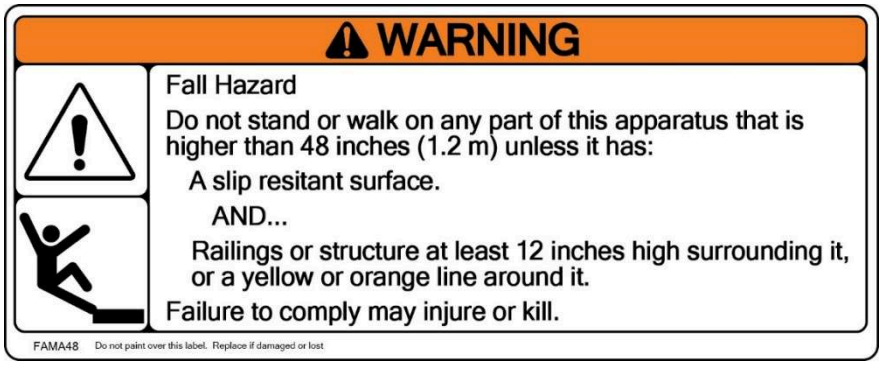
Slip Resistant Surfaces

The NFPA standards specify the performance that slip resistant surfaces must meet. Only step or walk on surfaces that are slip resistant. If you must walk or work on a surface that is not slip resistant, do so only in a controlled environment using fall protection equipment. In addition to fall restraint devices, use rubber mats or other means to keep you from slipping.

Designated Stepping, Standing and Walking Surfaces

If your apparatus was contracted for after January 1, 2016, it will have designated standing or walking surfaces at any location above 48 inches from the ground where you may need to access during normal operation. You can tell which surfaces are designated for standing or walking as follows:

- The surface will have a slip resistant surface. (Except for hose storage areas). AND….
- The surface will have a yellow or orange line surrounding it. OR…
- The surface will have railings or structure at least 12 inches high surrounding it.



Do not stand or walk on any feature of your apparatus that is over 48 inches above the ground unless it meets these criteria. Any surface over 48 inches high that does not meet these criteria must only be accessed using service ladders and a fall protection system or other safe means as determined by your fire department safety management personnel.

Some surfaces, such as diamond plate or tread plate may be used in construction of features that are not intended to be walked on. It may be used for aesthetic appeal, or to protect painted surfaces from wear. Just because a surface is constructed of diamond plate or tread plate does not mean that it is designated to be walked or stepped upon.

Folding Steps or Ladders

Certain steps or ladders may be of a pivoting or folding design. They may deploy automatically, or they may need to be deployed by hand. In either case, make sure they are firmly engaged in the weight bearing position before using them. Also make sure they are stowed again before placing the vehicle in motion.

Open Compartment Doors

When climbing or walking on the vehicle, never step on a horizontally hinged cover or compartment door that has been left open. Hold-open devices are not designed to support more than the weight of the door itself. Also, never step on the edge of a vertically hinged door that has been left open. In either case the doors will move and you are likely to fall

Working on top of the Apparatus

For those times when working on the top of your apparatus is unavoidable, you must use extra precaution from the moment you leave the ground.

- Stay away from the edge.
- Always use three points of contact.
- Only step on surfaces that are slip resistant.
- Never step on open, horizontal compartment doors.
- Never step on open, vertical compartment door edges.

Climbing Prohibitions

Do not step or climb upon any vehicle surface unless it is slip resistant and handholds are provided. Never climb using features on your apparatus such as lights, sirens, inlet or outlet valves, controls, compartment doors, or other non-climbing features.

Working around the Apparatus

Open compartment doors that extend out from the vehicle may create a head-strike hazard to others working in the area. Take the time to close compartment doors after you have retrieved your equipment. This goes the same for other items that hang off the apparatus such as deployable ladder racks, slide-out shelves, hose trays, portable tank racks, etc. If you are working at night, be sure to light up the area to reduce the risk of running into things.

- Use scene lights during night operation.
- Always wear your fire helmet when working around your apparatus.
- Keep compartment doors, trays and equipment racks closed or stowed when not in use.

RIDE SAFELY

Cab Capacity

Your apparatus cab is designed to carry a maximum number of occupants while it is motion. Never place the apparatus in motion with more than the maximum number as designated on the label in the cab and never without every occupant seated and belted

Seat Belts

Wearing your seat belt is the single most important thing you can do to keep yourself safe while riding in a fire apparatus. Put your gear on before you ride or plan to put it on after you arrive on the scene. Follow these rules to minimize your risk of injury during a crash:

- Always wear a seat belt when the vehicle is in motion.
- Ride with the seat back upright and your lap belt snug and low about the hips.
- Keep your shoulder belt snug against your chest.
- Never wear your shoulder belt under your arm or swing it around your neck over the inside shoulder.
- Never use a single belt for more than one person or one seating position.
- Place your seat belt inside the cab before closing the door.
- Have your belts replaced if they are damaged or worn.

Seat Back Position

Do not drive or ride with your seat back reclined. Your seatbelt may not function properly in a crash if the seat is reclined.

Shoulder Belt Positioning

If your seat belt is equipped with a height adjuster, use it to move the shoulder belt into the proper position as shown.

RIGHT
Shoulder Belt must be centered and lying flat across the chest, between neck and edge of shoulder.

WRONG
Shoulder Belt must not rub against face or neck. Move Seat Belt Height Adjuster down to correct.

WRONG
Shoulder Belt must not hang off shoulder. Move Seat Belt Height Adjuster up to correct.

Safest Posture

Seat belts provide the best restraint when:

- Seat back is upright.
- Occupant is sitting upright; not slouched
- Lap belt is snug and low on the hips.
- Should belt is snug against the chest.
- Knees are straight forward

Seatbelt Sliding Komfort Latch®

Your apparatus seat belts may be equipped with the Sliding Komfort Latch that allows you to introduce a small amount of slack in the belt to relieve pressure on your chest while driving.

- Do not introduce more than 1 in. (25 mm) of slack when using the Sliding Komfort Latch®.
- Using the seat belt with too much slack can reduce its effectiveness during a crash.
- Always disengage the Sliding Komfort Latch® when removing the seat belt to allow the seat belt to fully retract.

Transporting Children

Your apparatus occupant protection systems are designed to accommodate adult firefighters who may be wearing protective gear. It is not designed for transporting children. Do not transport children in your apparatus, they should be transported in appropriate passenger vehicles only.

Seats without Seat Belts

Your apparatus may be equipped with work areas that include seats without seat belts. These seats are meant to be used only when the apparatus is stopped with the parking brake applied and the wheels properly chocked. If the seats are in an area of the apparatus that is occupied during driving, make sure they are either bolted down or otherwise secured so that they do not become a projectile in a crash.

Swivel Seats

Your apparatus may be equipped with a seat that can be swiveled. The seat may be provided with multiple locking positions. Select the proper seating orientation before the vehicle is placed in motion and ensure that it is thoroughly engaged in the locked condition.

Air Bags

Your apparatus may be equipped with inflatable occupant restraints (air bags) that inflate if the apparatus rolls onto its side. Your apparatus may also be equipped with inflatable occupant restraints that inflate during a frontal crash. These air bags will only be effective in helping to protect you in a crash if you are also wearing your seat belt. Your seatbelt and associated safety devices will position you to allow the air bags to be effective in a crash. If your apparatus is equipped with both air bags and suspension style seats, then the system will include a device for pulling the suspension seat down to its lowest position prior to the air bag inflating. This will happen in a split second.

If your apparatus is equipped with air bags, you must learn where they are, where they will deploy and what other devices will deploy in a crash. Always follow these rules:

- Learn where each air bag on the vehicle will deploy.
- Do not place objects in the path of an air bag deployment.
- Do not cover seats with clothing or other items that will interfere with air bag deployment.
- Keep items and body parts away from the path of the suspension seat mechanism and seat belt tensioning devices.

Failure to follow these precautions may increase the risk of death or injury in a crash.

Cab Occupant Doors

Your cab hinged doors are designed with a first and second latch position. You can test this feature by closing the door so that the latch just rests against the striker, and pushing with a medium amount of force. You will be able to get the door latch to catch in the first latch position. The door will not be completely flush with the cab structure. Open the door and close it firmly to engage in the second latch position.

If your apparatus is equipped with sliding doors they will latch but may have only one latching position. Always close your hinged cab doors firmly so that they engage completely in the second latch position. Never place your apparatus in motion unless all occupant doors are closed and latched.

Helmets

Fire helmets are designed for a specific purpose and are not intended to provide protection in a crash. Wear your fire helmets when working around your apparatus, but do not wear it when your apparatus is in motion. Use approved helmet holders or other means of restraining your helmet in the event of a crash.

NFPA Instructions for Helmet Use in Structural Apparatus

Fire helmets shall not be worn by persons riding in enclosed driving and crew areas. Fire helmets are not designed for crash protection and they will interfere with the protection provided by head rests. The use of seat belts is essential to protecting firefighters during driving.

NFPA Instructions for Helmet use in Wildland Fire Apparatus

Serious head/neck injury can result from helmet use in cab. Do not wear helmet while seated unless necessary during suppression operations. Fire helmets are not designed for crash protection and they will interfere with the protection provided by head rests. Reduction of head clearance can increase the risk of spinal compression injury from roof contact. The use of seat belts is essential to protecting firefighters during driving.

SCBA Storage

Your apparatus may be equipped with SCBA storage in the seat backs. Some SCBA storage devices must be adjusted to the specific SCBA bottle size or SCBA pack make or model. Make sure the bracket is adjusted properly and that any straps, buckles or latches are fully engaged so that the pack will not come loose during a crash. Leave your pack straps off or keep them loose while sitting in the seat as the bracket is not designed to take the weight of both you and your pack during a crash. Before placing your apparatus in motion:

- Ensure SCBA bottles and packs are properly secured.
- Use seat back insert in seats were SCBA pack is not being stored.
- If wearing the SCBA harness, make sure it is loose.
- Place movable headrests in the closed position.
- Adjust SCBA holders for the SCBA pack make, model, and size.

SCBA Pack Buckles and Receivers

Your SCBA pack harnesses may be equipped with buckles and receivers that are similar to the buckles and receivers of your seat belts. Take care to ensure that you do not mistake one for the other. You will not be protected during a crash if the seat belt buckle is inserted into your SCBA pack receiver or vice versa.

DRIVE SAFELY

Controls Adjustment

It is important to keep your driving related controls properly adjusted for the person who will be driving. Make your adjustments at the start of your shift, and never make adjustment while driving. If you must readjust while driving, pull over when it is safe, stop the vehicle, place the transmission in neutral, apply the parking brake, and then make adjustments safely.

Adjust all controls prior to driving including the following:

- Steering wheel.
- Driver seat
- Mirrors
- Seat belt
- Sun visor

Driver Seat Adjustment

Adjust your driver seat at the start of your shift. Do not adjust seats with apparatus in motion. To obtain best ride quality, adjust suspension seats to the center of their vertical travel. Ensure proper reach to steering wheel and pedals.

Mirror Adjustment

Adjust seat before adjusting mirrors. Adjust your mirrors at the start of your shift.
Adjust mirrors in a way that will optimize visibility to the sides and the rear. Using a partner, have them walk around the sides and the rear of the vehicle to determine where the blind spots are. Make sure any exterior view cameras are pointed properly and that their lenses are clean and unobstructed.

- Know your blind spots.
- Adjust seats and mirrors at the start of every shift or before driving.

Visibility Check

Ensure that you have excellent visibility using the following checklist.

- Windshield glass is clean
- Cab side glass is clean
- Mirrors are clean
- Rear, side, or birds-eye cameras are clean and functioning
- Windshield wipers function and blades are in a condition to wipe thoroughly
- Washer fluid reservoir is full with commercial non-freezing washer fluid and washer sprayer is functioning.

Seat Belt Monitoring

Your apparatus includes a seat belt monitoring system that will alert you when an occupant is sitting in a seat but has not buckled their seat belt. Always check this monitor and do not release the parking brake until all occupants are seated and belted.

Know Your Tire Limitations

Fire apparatus axle weights are often higher than typical heavy trucks. Tire manufacturers recognize the need for fire apparatus to carry higher loads and that in most cases a fire apparatus does not travel at high speeds for long periods of time. Tire manufacturers will rate some of their tires with a special “fire service” intermittent duty rating. This allows the tire to carry greater loads or attain higher speeds as long as it does not have to do so for extended periods of time. To avoid tire degradation, fire service rated tires have limits on the amount of time they can be driven at high speed and high load before they must be allowed to cool down. Study your tire ratings, compare them to your in-service tire loads and know the speeds you can operate and any cool down periods that may be required.

FEMA Fire Tanker Guidelines

The US Fire Administration’s ”Safe Operation of Fire Tankers” report is available as a pamphlet from FEMA, or it is available as a download from their website. Read this report completely, learn about the precautions and techniques it describes, and practice driving your fire tanker or tender safely. This report ican be downloaded from the FEMA website at www.usfa.fema.gov.

Liquid Loads and High Center of Gravity

If your apparatus includes water, foam or other fluid tanks, you must take special precautions while driving. Liquid surge results from the movement of liquid in a partially full tank. There are two common times when liquid surge becomes a problem. The first is when you change directions, such as when negotiating a curve in the road. If you enter the curve too fast, centrifugal force will cause the liquid to surge against the wall of the tank and push your apparatus away from the turn. In severe situations, this surge can be sufficient to push you off the roadway or cause you to rollover.

Liquid surges will also affect your apparatus when stopping. During braking, the liquid surges toward the front of the tank. This additional force surging forward can further increase the stopping distance of your apparatus. After you come to a stop, the liquid in the tank will continue to slosh back and forth. On slippery road surfaces, this could cause your apparatus to be pushed forward into a hazard such as an intersection or a railroad crossing. Whenever possible, do not drive with partial water loads. Keep the water tank full or empty when driving.
In addition to the hazard of a liquid load, your apparatus has a higher center of gravity (CG) than a passenger vehicle. A high CG makes your apparatus more likely to roll over in a turn. Never exceed the posted cautionary speed limit.

These combinations of factors mean that you need to slow down and be extra careful when making maneuvers such as:

- Lane changes.
- Curves at highway speeds.
- Tight radius turns.
- Downgrades leading into ramps.
- Curves on roads without a bank.
- Tight radius exits and off-ramps.
- Driving on any road with a cautionary speed limit posted.

Driving on Rough Roads

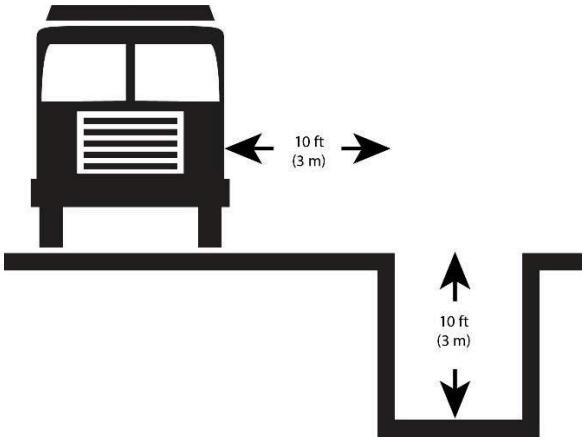
Your apparatus is primarily designed to operate on smooth paved surfaces. Driving on un-paved or poorly maintained roads will require you to slow down and proceed with caution. Your seating systems may not compensate for severe road conditions leading to injury. Slow down and use caution prior to encountering severe road conditions such as:

- Potholes, ruts or sinkholes
- Speed bumps
- Railroad crossings
- Road construction

Driving Off-Road

When you leave the public roads you must take extra precautions to ensure the safety of yourself, your vehicle, and those around you. It is likely that your apparatus has higher axle weights than typical off-road capable trucks and will be more susceptible to sinking into soft soil. A fluid load and higher center of gravity also require additional caution. Know the capability of your apparatus and follow these guidelines:

- Always drive straight up or down a hill; never drive sideways on a hill.
- Get out and look. Walk the terrain before proceeding into unknown conditions.
- Check off-road conditions in your response area ahead of time so that you will know what to expect.
- Stay clear of excavations that are not properly shored up. Stay as far away from an excavation as it is deep (One to one ratio rule).
- Look for off-road hazards such as marshy areas, buried culverts, private bridges, animal dens, or other features that may not support your weight



One-to-One Ratio Stay-Away Rule

No-Spin Axle Differential

Your apparatus may be equipped with a No-Spin differential or differential lock. With this feature engaged, use extreme caution when accelerating or decelerating on slippery or unstable surfaces. Vehicles equipped with traction or locking differentials are inherently more sensitive to side-slip.
Operate in low gear when coasting downhill into a turn. Braking capacity is reduced when a No-Spin or locking differential equipped vehicle makes a turn while coasting downhill.

Tire Chains

Never install tire chains on the steer tires. Installation of tire chains on the front tires may cause extensive damage to the cab as well as safety critical parts of the steering and brake systems. Damage to these components may lead to serious injury or death.

Water Fording

Your apparatus is not designed for operation in deep water. Your apparatus is capable of fording fresh stationary water at a depth not to exceed the center of the tire at slow speeds and for short distances only. Fording deeper water, at faster speeds, and for longer distances, can damage apparatus components leading to equipment failure, loss of apparatus capability, and expensive repairs. Never drive into flowing water like flash floods, rivers, creeks or streams. Flowing water has tremendous power and can sweep your apparatus away.

Components that will be affected by high water operation include:

- Engine air intake. – Water in the air intake will cause the engine to stop and may cause extensive damage.
- Drive Axles – Breathers on the top side of drive axle housings can ingest water causing axle gear damage.
- Engine Fan – Operating in high water can cause fan blade damage
- Electronics – Connectors, wiring, electronic modules, can be damaged or shorted out by submersion.
- Batteries – Submersion of the apparatus batteries will kill the batteries and stall the engine.

Operation in salt water will cause damaging corrosion and lead to equipment failure.
Always know the depth of water before proceeding.

Heater Shut-Off Valve

Your apparatus may be equipped with a heater shut-off valve. This valve may have been specified by your department to ensure that there is no hot coolant supplied to the cab heater core during hot seasons of the year. Use this valve with caution and make sure it is open whenever needed. Use of the heater shut-off valve will prevent warm air from circulating through the defroster system and may lead to a reduced ability to clear humidity from the windshield and subsequent reduced driver visibility.

STOP SAFELY

Brake System Pressure

Your apparatus braking system relies on air pressure created by a pump that runs off the apparatus engine. Do not release the parking brake and move the vehicle until the front and rear air gauges indicate at least 60 psi in both circuits. 100 psi is preferred for maximum stopping capability.

Anti-Lock Brake Systems

Your apparatus is equipped with an anti-lock braking system (ABS). ABS monitors the rotation of the wheels and pulses the brakes when it senses a skid. This can help you maintain control in during a stop. ABS can greatly increase the control you have when stopping on wet or slippery surfaces, but it cannot provide more braking performance than the road conditions will permit. Your apparatus is big and heavy and should always be operated with caution knowing that it takes a lot of energy to bring it to a stop.

Maintaining Control

- Do not pump brakes on vehicles equipped with ABS. Anti-lock type brakes pulsate to prevent lock-up. Pumping brakes defeats the anti-lock function.
- Hold the steering wheel with both hands on opposite sides of the wheel.
- Always look 12 to15 seconds ahead of where you are driving.
- Ensure adequate distance between the vehicle you are driving and the vehicle ahead. Braking distances can double when the vehicle is loaded.

New Brake Lining Performance

If your apparatus has had its brake linings replaced, they will need to be broken in before they will perform as well as the old linings did. Brake linings need to be "burnished" after installation. This is the process of wearing the high spots off the linings so that they grab over their entire surface. Be alert to any service work on your apparatus involving brake lining replacement and adjust your driving accordingly. The vehicle's stopping distance and the capability of the vehicle to hold on a specific grade may decrease temporarily whenever new brake lining material is installed.

Quick Build-Up Air Brake Pressure System

Your apparatus may include a quick build-up air brake feature as required by **NFPA® 1900** *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances*. The quick build-up feature allows the vehicle to be driven even though the front air brake reservoir may not have sufficient air pressure to enable sustained or full force braking.

While this is a requirement of the NFPA standard, it is not recommended ever beginning to drive your apparatus without the air reservoirs fully charged. If you chose to make use of the quick build-up feature you must drive slowly and cautiously until your brake reservoirs are charged to above 60 psi.

You can reduce the risk of leaving for on a call with low air pressure by always connecting the air brake system to an external air supply whenever it is in the station.

Auxiliary Braking Systems

If your apparatus is over 36,000 lbs. GVW, it will be equipped with one of the following auxiliary brake systems:

- Allison transmission retarder
- Telma electromagnetic retarder
- Jake Brake
- OEM Engine Compression brake
- OEM Exhaust brake

All of these systems apply braking force through the drive wheels only.

During slippery road conditions or inclement weather, an auxiliary braking system may cause rear wheel lock-up and loss of vehicle control. Turn your auxiliary braking system(s) off before encountering slippery conditions. If you forget or fail to turn off your auxiliary brake in slippery conditions and begin to lose control, apply the service brakes and make a safe stop. If the ABS senses a loss of braking control, it will disengage the auxiliary brake and initiate an ABS event, helping you maintain control.

Descending Steep Grades

You should use a combination of service brake application, transmission down-shifting, and auxiliary braking when descending a steep grade. Anticipate steep grades and downshift before you begin to descend. Downshifting to a lower transmission range increases engine braking and helps you to maintain control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected. Service brakes can overheat and lose effectiveness if used too much. To help avoid loss of control, use a combination of downshifting, braking, and other retarding devices.

Electronic Stability Control

Your apparatus may be equipped with an Electronic Stability Control (ESC) system. This system knows which direction you are pointing the wheel and pumps the brakes appropriately to help point the apparatus in the direction that you are turning. This system is most effective on slippery surfaces.
ESC cannot prevent accidents or loss of control of the vehicle. You can still exceed the physical limitations of the system with either excess speed or extreme cornering, causing a loss of directional control or rollover.

Parking Brakes and Wheel Chocks

Your apparatus has a parking brake knob that must be engaged any time you leave the driver's seat. You must always place the transmission in Neutral (N) and then engage the Park Brake. As soon as you leave the cab, you must chock the wheels. Wheel chocks will help keep your apparatus from rolling in the event that the parking brakes malfunction or are released unintentionally.

Auxiliary Front Wheel Lock

Your apparatus may be equipped with an auxiliary front wheel lock system. The auxiliary front wheel lock feature uses air brake system pressure to keep the front brakes applied while parked. This system uses air pressure (rather than a passive spring) to keep the front brakes engaged and should only be used with the engine running and a qualified attendant present at all times. This feature is meant to enhance the parking performance of the vehicle, but it does not take the place of the spring brakes or the act of chocking the wheels. Always use wheel chocks.

Backing Your Apparatus

According to the National Safety Council, one out of four vehicle accidents can be blamed on poor backing techniques. Avoid backing hazards by planning ahead and avoid situations where you will need to back up:

- Choose pull-through parking spaces.
- If parking in an alley, back into it so that you are pulling forward onto the street when you leave.

Before backing:

- Get to know your vehicle's blind spots. In a typical truck, blind spots can extend up to 16 feet in front of and 160 feet behind a vehicle. Use a helper who can walk around your vehicle while it is parked to get to know when you can and cannot see them. Remember, mirrors can never give the whole picture while backing.

- Check for people, children or obstructions in the area.
- Check for soft soil, potholes, tire hazards, low hanging trees, powerlines or other dangers.
- Agree with your spotter that they will use hand signals and make sure your both understand their meaning.
- Equip spotter with reflective vest or other reflective gear.
- If backing at night, provide spotter with illuminated wands.

While backing:

- Use a spotter to assist
- Don't allow your spotter to walk backwards while giving instructions.
- Keep your spotter in your mirror and don't let them stand in the path of your apparatus.
- Place your transmission in reverse and listen for the back-up alarm before taking your foot off the brake.

PARKING SAFELY

Parking on a Grade

Park on level ground whenever possible. Never park on a steep grade (a grade that is more than 20 percent). A 20 percent grade means that the ground rises one foot vertically for every 20 feet of horizontal distance. Your apparatus is not designed to park safely on any grade that is steeper than 20 percent.
When parking on any grade, set the parking brake and then remove your foot from the service brake pedal slowly. Observe the ground to make sure your apparatus is not moving. If your apparatus moves, relocate your apparatus to a more level location. Chock your wheels immediately upon exiting.

Park away from Fire

When positioning your apparatus at a fire scene, be aware of where the fire is and where it is likely to spread. Park up-wind from the fire and in an area where the apparatus will be protected from direct heat and flames. High heat will melt lights, damage paint and, in extreme cases, catch the apparatus on fire.

Burning embers in the engine air filter can start the engine and vehicle on fire. Your apparatus is equipped with an ember screen to reduce the likelihood of burning embers catching the air cleaner media on fire, but it is not a guarantee. Determine where the air intake opening is located on your apparatus and avoid running the engine in an ember-rich environment to minimize any possibility of catching the rig on fire.

Park away from Fuel Vapors

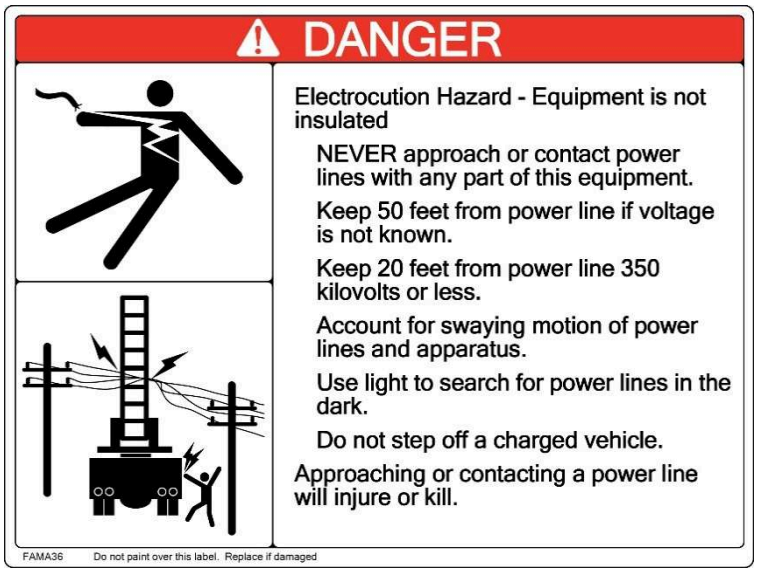
Your apparatus is powered by a diesel engine. A diesel engine does not require a spark for ignition and will continue to run as long as there is fuel available. If you run your engine in an atmosphere that is laden with fuel vapors, such as at a fuel spill or gas leak, the engine may increase speed uncontrollably. If turning the ignition switch or battery switch OFF does not cause the engine to stop running it may be in a runaway situation. The only way to stop the engine in this situation is to eliminate the fuel source. Engage the emergency engine stop (if so equipped), eliminate the source of the fuel vapors, or cover the engine air intake to starve the engine of air and vapor

Leaving Apparatus Unattended

Never leave your apparatus unattended. If your apparatus includes an aerial device, stow the aerial and retract the stabilizers. Park the apparatus in a secured location, and take other precautions as necessary to ensure that unauthorized personnel are prohibited from operating it.

Park away from Power Lines

Look up and live. Always check the area and identify power lines before positioning your apparatus. Make sure you are well clear of power lines before raising equipment such as aerial devices or light masts. Never climb onto the apparatus if it will bring you closer than 20 feet from an overhead wire. Overhead power lines are not insulated. Some lines have a weather covering and appear to be insulated; they are not.

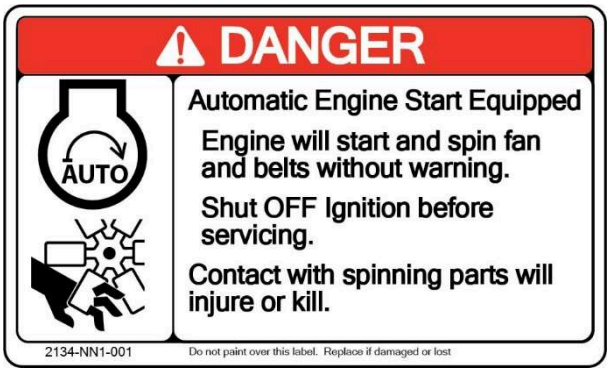


You or your apparatus do not need to touch a power line to be energized. Electricity arcs across ionized paths of air when a conductor is close enough. Consider all overhead wires or cables to be hazardous and dangerous. Never touch the outside of a vehicle you suspect may be energized while you are standing on the ground. Electricity will flow from the vehicle through you and into the ground. Move away from the vehicle and stay away. Warn others to stay away.

Unless the vehicle is on fire, it is safer to stay in the charged vehicle than to attempt to exit. If it is necessary to exit the vehicle, jump as far away as possible while landing with both feet together. Maintain your balance. Fall forward and away from, rather than backward and towards the vehicle. Once clear of the vehicle, don't return until a power company representative confirms that it is safe and that the line has been de-energized and grounded. Do not attempt to rescue a person in or on a charged vehicle.

- Look up and live.
- Stay in or on a charged vehicle.
- Stay away from vehicles charged by power lines.
- Keep vehicle, people and equipment away from power lines.

Idle Mitigation



Your apparatus may be equipped with idle mitigation technology to improve fuel economy and reduce the carbon footprint of the apparatus. This system shuts the main chassis engine off and then starts it again when the idle mitigation batteries require recharging. When the engine starts, the fan, belts, and other components will spin. Keep hands, clothes and other body parts clear of all powertrain components. Never crawl or work beneath your apparatus or work near your apparatus powertrain unless the ignition switch and the battery switch are both in the OFF position. Use lock-out tag-out procedures before servicing or maintaining.

Winch and Rope Anchors

Your apparatus may be equipped with a hitch receiver or other device intended to anchor a portable winch or to be a tie-off point for rope operations. Pulling in a direction other than a straight line away from these anchors must be done with extreme caution. Your anchor is designed for maximum pull in a straight line away from the apparatus only. Align your apparatus with the pull or the capacity of the anchor will be significantly reduced and you risk an anchor failure.

FUEL SAFELY

- Before fueling, turn off the engine. Put your apparatus in neutral, set the parking brake, turn off the ignition switch, and chock the wheels.
- Use only ultra-low sulfur diesel fuel (15 ppm sulfur).
- Disable or turn off any auxiliary sources of ignition such as on-board fuel operated line-voltage generators or fuel-fired heaters.
- Do not smoke, light matches or lighters while refueling.
- Use only the refueling latch provided on the dispenser nozzle.
- Stay at the nozzle until the tank is full.
- Never blend gasoline, gasohol and/or alcohol with diesel fuel. This practice creates an extreme fire hazard and under certain conditions an explosive hazard.
- Check and fill the DEF tank with DEF if required.
- Never add DEF to the Diesel fuel tank, and never add Diesel fuel to the DEF tank. In either case severe engine and/or emissions system damage will occur.

BEFORE PLACING YOUR APPARATUS INSERVICE

No truck should be placed into service if there is any doubt or evidence of improper or inadequate function of any of the components or systems.

Install Electronic Equipment Properly

Do not add electrical devices to your apparatus unless they are installed by qualified service technicians who understand how to provide proper circuit protection. Always replace fuses or circuit breakers with the correct size. Improper fuse or circuit breaker sizing can cause wires to overheat and burn.
Do Not Install Equipment in Air Bag Path

If your apparatus includes Inflatable Occupant Restraints, determine where each of the air bags is located, and where their deployment path will be. Never mount equipment in the path of an air bag. This includes the following areas.

- The outboard area between a seat and the side of the cab.
- Between the front passenger seat and the dash (officer knee area)
- Between the driver seat and the dash (driver knee area)
- Under any seat suspension
- On the steering wheel

Install Front Bumper Mounted Equipment Properly

Avoid mounting equipment in a manner that blocks airflow to the grill. Large items blocking air to the grill may degrade cooling performance and cause the engine to overheat during heavy use and high ambient temperatures. When mounting equipment to the bumper deck plate of a tilt cab, consider the motion of the cab when tilting to avoid interference in the tilted condition.

When mounting equipment to the bumper deck plate, do not block headlights, warning lights or flashers, turn signals, and side markers. Blocking any of the above can put the apparatus and personnel in danger of a collision that may cause injury and/or death.

Install Cab Interior Equipment Properly

Consider the effect of cab tilt on equipment storage to avoid damage from items falling forward when the cab is tilted for service or maintenance.

Monitor the weight of items installed in a tilt cab, or stored in tilt cab storage areas. Too much weight inside the cab may prevent the cab from being tilted for service or maintenance.
Refer to NFPA guidelines when mounting equipment inside the cab to avoid unnecessary risk of injury from flying objects during a collision.

Use caution if drilling into cab walls and headliners to mount equipment, as there may be wiring, heater hoses, or air conditioning hoses hidden beneath the surface.

Never mount any equipment in the deployment path of an air bag, seat belt pretensioner, or suspension seat pull-down device.

Install Air Pressure Operated Equipment Properly

Any air-operated equipment must only be added to the air system downstream of a pressure protection valve. Consider the airflow requirements of any air-operated accessory that will draw pressure from the vehicle system. The engine air compressor output is but a fraction of its total capacity at engine idle and will not keep up with the continuous operation of most shop-type air tools.

Pressure protection valves are installed in both front and rear brake systems to ensure that no other air pressure requirements of the vehicle are allowed to deplete the vehicle braking system capabilities.

Addition of any air pressure equipment added by the end user up-stream of these pressure protection valves will negate the conformance of the vehicle to this NFPA recommendation and property damage, personal injury and/or death could result.

Consider Dissimilar Metals when Mounting Equipment

Consider the metal types whenever mounting accessories. Dissimilar metals placed in direct contact with each other and subjected to moisture will form a galvanic reaction that will lead to rapid corrosion and possible failure of the mount, fastener, or base material. Select mounting material and fasteners to avoid dissimilar metals, or coat all mounting surfaces, base material, and fasteners with a commercial grade-rust proofing agent such as those conforming to MILC-0083933A specification.

Load your Apparatus Properly

Before placing the apparatus in service, load all compartments with the intended equipment and manpower. Top off all fluid tanks and obtain front and rear axle weights from a certified scale. Compare the results to the axle capacities listed on the Federal Motor Vehicle Safety Standard (FMVSS) information decal located inside the cab. In-service weights must not exceed the axle capacities listed on the tag. If the scale weights are higher than the gross axle weight rating (GAWR) values listed on the label, move or remove equipment and re-weigh the apparatus until you are within the axle's limits.

Once you have each axle within its GAWR limits, obtain individual wheel weights and be sure you are within 7% weight difference from side to side.

Establish a routine of repeating the axle weight review at least annually to ensure that changes in equipment storage or other variables have not increase the axle loading beyond their placarded capacity.

Establish Correct Tire Pressure Values

Use the in-service axle weights to determine the correct tire pressure values using the latest information from your tire manufacturer (available on-line). Each tire manufacturer provides charts that will tell you the proper tire pressure for the load that the tire is carrying. Be sure to use the correct data based on your specific tire make, model, and size. Record the correct tire pressure settings on your vehicle inspection checklist. Adjust your tire pressure to match these values.

NOTICE

The tire pressure indicated on the FMVSS label located in your apparatus cab will be based on loading your tires to the Gross Axle Weight Rating (GAWR). If your apparatus in-service axle weight is less than the GAWR, then you should decrease the tire pressure to the correct value based on your in-service load. Failing to do so will reduce handling performance and lead to a rougher ride.

Leaf Spring Suspensions with U-Bolts

Your apparatus may be equipped with a leaf spring suspension at the front, the rear, or both. Leaf springs can settle during the initial run-in process, dropping by as much as 0.50 inches. U-bolts must be tightened to their proper torque after the first 500 miles of apparatus driving, or 500 miles after a spring has been replaced.

Safety Equipment

Ensure that all of the safety equipment required by NFPA, your department policy, and applicable regulations are on the apparatus or available including:

- Personal Protective Ensembles.
- Fall Protection Belts, Tethers, or Harnesses.
- Wheel Chocks.
- Traffic Cones or Flares.
- Fire Extinguishers.
- Safety Vests
- AEDs

Demonstration and Training

Factory or dealer demonstration may be provided to familiarize you or a department with the apparatus. Training is the responsibility of the department and should include instruction, experience, and skills testing. All personnel that will operate the apparatus should have completed department authorized training in accordance with NFPA 1451 *Standard for a Fire and Emergency Service Vehicle Operations Training Program.*

USING HOSE SAFELY

Storing, Deploying and Retrieving Hose Safely

Your apparatus may be equipped with hose storage areas. There are hazards related to stowing and laying hose and you must develop safe procedures for doing both.
Your department may choose to drive your apparatus during the hose laying or stowing procedure. This must be done with extreme caution and under the supervision of fire department authorities. Your apparatus is designed to transport personnel while seated and belted in the cab only. Any procedure that involves personnel riding on the apparatus, working around a moving apparatus or handling hose that is being dropped off a moving apparatus, involves risks that your apparatus was not designed to avoid. Understand these risks and develop your safety procedures accordingly. Your procedure should address the following risks:

Snags and Snarls

Hose storage areas may have structural features or components that can snag hose while it is being pulled out. Such features may include hose chutes, hose bed cover supports, emergency lighting, access steps, hand rails, pre-connect piping, etc. You will need to develop hose packing and deploying methods that will reduce the possibility of snags.

Pack hose carefully in any hose storage area to minimize the risk of hose or connections snagging or snarling during deployment. Hose that snags or snarls during deployment from a moving vehicle can whip violently, causing death or injury.

Slips and Falls

Develop hose practices that will protect yourself and others from slips and falls. This may include the use of auxiliary ladders, scaffolding, safety harnesses or other methods while stowing hose in areas that are high up on your apparatus.

Driving while Deploying

If you choose to drive your apparatus to deploy hose, never drive faster than you have determined to be safe, and definitely never faster than 5 mph (8 kph). Your apparatus is very heavy and powerful. It will not be stopped by a hose. If the end of the hose is held firmly to a hydrant or other object and the deploying hose catches on part of the apparatus, the hose in between will whip violently and forcefully causing damage, injury or death.
Do not stand on or near hose and hose couplings when vehicle is moving. Never wrap hose around you or others while deploying. Serious injury may result.

Driving while Retrieving

Do not reload hose by backing the vehicle up while personnel are walking behind the vehicle. This is an extremely hazardous practice. Drive forward over the top of the hose so that you can always see where you are driving. Stop after each section has passed the rear bumper, place the transmission in neutral, and apply the parking brake. Only when you are sure the vehicle is stopped and the parking brakes are set should you signal that it is safe for personnel to approach the apparatus and load the section of hose that is now behind the vehicle. When that section has been loaded, clear the area and drive forward over the next section. Repeat this process until all the hose has been loaded.

Consider other methods such as using hose rolling devices that make it easy to roll each section of hose and wheel it by hand to the parked apparatus. Whatever method you choose, always place the safety of your crew ahead of time or efficiency considerations.

Hose Bed Covers

Your apparatus may be equipped with solid hose bed covers. These covers are heavy and will be affected by strong winds and the grade the vehicle is parked on. The vehicle should be parked on level ground when the cover is lifted. Do not lift the cover in strong winds. Use two people to lift the cover. Make sure the cover restraining devices are in place and secured before releasing the hold of the cover. Make sure personnel have a secure hold of the cover when releasing the restraint device. Failure to follow these instructions could result in serious injury.

Hose on the Fire Scene

If your apparatus is equipped with a pump it can produce very high water pressure. Fire hose under pressure can burst without warning. Use only tested hose with your apparatus and never straddle or stand over a charged hose. Hose fittings can fail without warning. Inspect hose fittings for cracks, chips or other damage and replace when worn or damaged. An uncontrolled hose discharging foam or water will whip violently. Never pressurize a hose unless the discharge nozzle is closed and the nozzle is held or secured firmly.

Testing Hose

Your apparatus was never designed to be a hose testing device. While **NFPA 1962** *Standard for the Care, Use, Inspection, Service Testing and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances* does include a procedure for using a stationary pump or apparatus for hose testing, we recommend employing a proper hose testing machine as a much safer alternative. Hose test machines can develop the required test pressure at very low power levels. Since the whole point of hose testing is the assumption that your hose has seen service that might render it incapable of standing up to the test pressure, it is much more prudent to perform hose tests with the proper equipment. WE CANNOT BE RESPONSIBLE FOR INJURY IF YOU DECIDE TO USE YOUR APPARATUS TO TEST HOSE AS YOUR APPARATUS WAS NOT DESIGNED TO DO SO SAFELY.

DISCHARGE WATER SAFELY

Your water pump is a powerful machine which can hurl many tons of water every minute. This type of power can do great good in suppressing fire, but it can do great damage if not handled properly. Always treat pressurized hose and piping with the greatest respect and be thoroughly trained on safe pumping procedures before operating your pump. Be sure to avoid the following potential hazards:

Water Stream

You should use water streams for fire suppression only. Never direct your water stream at a person. Never open a discharge valve where the stream could strike a person. Water streams may knock people to the ground, causing injury or death.

Power Lines and Fire Suppression

Water is a conductor of electricity. Recognize the ability of water to conduct electricity. Never spray water around high voltage electrical wires. Electricity can travel down a water stream. Never spray water or foam through or onto live electric wires.

Boiling Discharge Water

It is essential that you always keep your pump water cool. This means that you must always circulate cool water through the pump. Your apparatus may include a recirculation valve that must be opened, or your apparatus may require the tank-to-pump valve be open and the tank-fill valve to be opened slightly. You must know how your pump works and the necessary steps to keep the water cool. A pump without a constant supply of cool water flowing through it can quickly overheat the water. Hot water and steam may cause severe burns if overheated water is discharged on you or another person.

Matching Equipment to Pump Pressure

Your apparatus was manufactured with fittings, valves and piping connections as specified by your department. You must be sure that fittings, valves, connections, hoses and nozzles that you use with your apparatus are compatible, tested and capable of the flow rates and pressures that you will be using them with. Hoses, valves and fittings can explode if pressure capacity is exceeded. Never exceed the working pressure of downstream devices.

Pump Operation

Your pumping apparatus will power the pump using either the main truck driveline, a power-take-off from the engine or transmission, or a separate dedicated engine. You must study and learn how to properly engage, disengage and operate the pump on your apparatus. As a custom apparatus, every pump control layout may be different as specified by your department. The operation of your pump was demonstrated by your apparatus dealer at the time of delivery to members of your department who are responsible for training you in proper operation. Also study the IFSTA *Pumping and Aerial Apparatus Driver/Operator Handbook* to learn critical information on proper pumping procedures.

Emergency Pump Procedures with Failed Engine Control

Your apparatus may control pump pressure with a manual engine control and a relief valve or with a pressure governor. In either case, you should learn what to do if your primary pump control fails. Many apparatus can continue to pump after a control system failure by stationing an operator in the driver's seat and having them control engine speed with the foot accelerator. This procedure can be used in an emergency, but the firefighters on the lines should be immediately recalled from imminent danger, and the apparatus should be replaced on the fire scene as soon as possible. Take great care to keep a steady foot on the pedal to avoid sudden fluctuations in pressure.

Pressure Fluctuations

Sudden changes in water pressure are hazardous to firefighters at the end of a hose. Rapidly fluctuating pressure in a fire hose can cause the hose to whip. You must learn to avoid the many causes of pressure fluctuation including:

- Turning off a pressure governor.
- Sudden adjustments to engine speed.
- Opening or closing valves too quickly.
- Failing to remove air from pipes and hoses.

Always bleed the air from the intake lines before opening the intake valve at the apparatus. Stay alert for fluctuations in hose pressure and react quickly and safely when they do occur.

Intake and Discharge Caps

Your pumping apparatus may be equipped with either threaded or Storz-type couplings. In either case, you must avoid the hazard of removing intake or discharge caps that have pressure behind them. Intake and discharge caps can trap pressure if the valve controlling the connection is opened and then closed again when there is pressure in the system. This pressure can remain trapped between the cap and the valve for a long time. Always open the drain or bleeder valves first to relieve any pressure that may be trapped behind the cap before attempting to remove it. Open caps slowly and never stand in front of a cap during its removal. If you open a cap with pressure behind it, the cap may blow out at you with extreme force. You or others may be injured or killed.

Pump and Roll

Your apparatus may be designed to Pump and Roll. This means that you can discharge water while the apparatus is moving. This may be beneficial for fighting grass or wildland fires. While the apparatus may have this capability, you must take particular care if you use this capability.

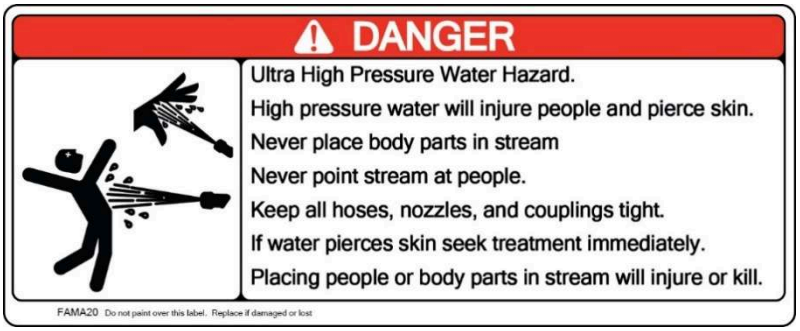
Remember that your apparatus is designed to transport personnel only if they are seated and belted. You should only discharge water from a moving apparatus by using a method approved by the National Fire Protection Association. If you choose to move the apparatus with firefighters using charged lines walking with the apparatus, use the following precautions:

- Drive at slow speeds only.
- Always stay clear of a backing vehicle.
- Never walk in front of a moving vehicle.
- Keep walking personnel alongside the apparatus and in view of the driver at all times.
- Keep walking personnel far enough from the apparatus so that they won't be crushed if the apparatus were to roll onto its side.
- Develop and practice procedures to get walking firefighters quickly into the apparatus and belted into a seat in the event that the fire shifts, and you need to retreat from the area.

High Pressure Two-Stage Pump

Your apparatus may be equipped with a two-stage high pressure pump. A two stage pump can be operated in the VOLUME mode at typical municipal fire suppression pressures of 80 to 120 psi (550 to 690 kPa). In the PRESSURE mode, this same pump can discharge at pressures up to 600 psi (4140 kPa), useful for charging standpipes in high rise structures. Normal fire suppression hose, nozzles, wyes, and other appliances are not likely to be rated for these high pressures. Train your personnel to use only specially rated high pressure hose and components when operating in the PRESSURE mode.

Ultra-High Pressure Water Stream



Your apparatus may be equipped with Ultra High Pressure (UHP) streams of water or foam solution to fight fires. UHP presents unique hazards and should be used only by trained, safety-conscious personnel. UHP water or foam solution is discharged at pressures over 1,000 psi. At this pressure, the discharge stream may be capable of puncturing human skin, thus entering the blood stream. Personal protective equipment (PPE) such as gloves, turn-out gear, boots and a mask with a face shield should be worn whenever using UHP.

Tighten all fluid connections before operating this equipment and check the hoses, nozzles, and couplings after every use. A leak in a high pressure line can inject fluid into human skin just as it can from the nozzle. Never search for leaks with your hands or other body parts. Use a piece of wood or cardboard to detect leaks, keeping hands and other body parts well away from the potential source of the leak. Replace worn, damaged or loose parts immediately.

Ultra-High Pressure Piercing Equipment

Your apparatus may be equipped with an ultra-high pressure device used for piercing structural material. These devices use an aggregate added to the water stream that will cut through solid objects. It will also cut through skin and bones. Use safety precautions and treat a UHP piercing device with all the respect you would use with a firearm.

Foam Concentrate Types

If your apparatus is equipped with a foam system, you should know and understand the type of foam solution that it's capable of using. Never mix brands or types of foam concentrate, or the foam produced may not be adequate for the fire suppression capability desired.

Water Monitor

Your apparatus may include a water monitor on the front bumper, cab roof, apparatus top, or other location. You may also choose to use a ground monitor when pumping. Following these practices when discharging water from a monitor:

- Charge your monitor slowly. Rapid charging may cause a pressure surge which has the potential to cause an injury, or damage the monitor.
- Aim your monitor in a safe direction before discharging water.
- Never direct the stream at power lines or people.
- If there is a nozzle attached, ensure that it is tight and not over tightened before using the monitor. Do not use with a loose nozzle. A loose nozzle is a dangerous projectile. Ensure the thread on the nozzle swivel matches the thread on the monitor outlet. Do not over tighten the nozzle onto the unit.
- Read and follow the warning tag instructions on the lock pin lanyard.
- Do not exceed the maximum pressure or flow ratings of the monitor. Exceeding these ratings may lead to an injury or may cause damage to the monitor.
- If not equipped with the automatic drain valve, drain the monitor after use to prevent freeze damage.

Ground Water Monitor

In addition to the above instructions, a ground monitor (water monitor not attached to your apparatus), must be properly secure staked down or otherwise secured before use. Water discharge force will cause a loose monitor to fly about with great force causing injury or death.

AERIAL SAFETY

Your aerial device is a very complex machine that requires specific knowledge, training and experience to operate safely. You must study and learn how to properly set up and operate your aerial device. Study this manual and the IFSTA *Pumping and Aerial Apparatus Driver/Operator Handbook* to learn the proper procedures.

Emergency Stop Feature

Your aerial device will have an emergency stop (E-Stop) feature at the primary operator station controls. This may be a switch on the panel, or an operator presence foot pedal. This is a very important safety feature on the aerial. If something goes wrong and the aerial is behaving in a manner you don't understand, use the emergency stop feature to stop all aerial functions.

Once aerial functions have ceased, clear personnel from the area and determine what is wrong before resetting the emergency stop feature and continuing operation. Practice using the emergency stop feature during training sessions until it becomes second nature so that your mind will react quickly in an emergency.

Emergency Power Unit

Your aerial device uses power supplied by a hydraulic pump that is driven by a power-take-off from the engine. It is always possible that a mechanical, electrical or hydraulic failure can occur that will interfere with the operation of your aerial device. The Emergency Power Unit (EPU) will provide back-up power and, in most cases, allow you to continue operation until you can recall personnel from harm's way, stow the device and remove it from the fire scene for repair. Do not rely on the EPU for extended use as it is not designed for continuous operation.

Over-Ride Controls

Your aerial device is certain over-ride features that will allow “out of the ordinary” operation in certain cases of equipment malfunction. You should learn where these controls are located and how to operate them. Practice using your override controls until you are just as proficient with them as you are with the standard controls.

If the normal control system does malfunction, recall personnel from harm’s way immediately and take the device out of service until it can be repaired. Use emergency override controls with extreme caution and only when all non-essential personnel are well clear of any hazard.

Interlocks

Your aerial apparatus will be equipped with a number of interlock functions, many of which are required by **NFPA® 1900** *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances*. Interlock devices are intended to reduce the possibility of unsafe actions, but they should never take the place of careful, thoughtful and prudent operation. Interlocks rely on the proper functioning of sensors, wiring, relays and computers. These are physical components that have finite lives and can fail from a number of causes such as wear, corrosion, accidental damage or aging. You should identify each interlock and develop a procedure on how to safely ensure that each is functioning.

Aerial device interlocks may include:

- **Stabilizers Set**: The aerial device will not operate unless the stabilizers are deployed.
- **Nozzle Stow**: Device will not drop into the cradle if the master stream nozzle is not properly positioned.
- **Body Collision**: The device will not move into regions where it would make contact with the body or cab.
- **Maximum Elevation Slow-Down**: The device will slow down prior to reaching maximum elevation or extension.
- **Rotation Interlock** (Short-Jack): The aerial device will not rotate over the side of the apparatus where the stabilizers are not fully extended.
- **Tiller Operator Interlock**: Engine starter will not work unless the tiller operator is seated and belted, or a tiller cab start button is engaged.
- **Aerial Function Interlocks**: The aerial device will not operate until the parking brakes have been set, and the transmission has been placed in neutral, or the transmission is in the drive position and the system in pumping mode.

PREPARING FOR SAFE AERIAL OPERATION

Select a Site

Selecting the right spot to position your aerial apparatus is critical. You must anticipate fire ground needs and identify areas where to position so that the aerial tip can reach your intended targets. Select a position that will support your apparatus weight and meet all of the following criteria:

- Clear of areas exposed to falling debris.
- Clear of overhead power lines.
- Flat enough to allow leveling within the green or yellow zone.

- Firm and stable surface. Avoid loose objects, underground utility access covers, broken pavement and areas that drop off suddenly.
- Never position on a railroad track or an active airport runway.

Set-Up

Once you have selected a set-up location, clear the area of personnel and use spotters to maneuver your apparatus into position. Follow the instructions in this manual to place your apparatus in operation ensuring the following:

- Use stabilizer pads (if equipped).
- Keep the stabilizers in your sight at all times while deploying.

Setting Up within Safe Limits

Your aerial device must be within a few degrees of being level for safe operation. Check your level indicators to make sure that the device is properly leveled. The correct angle reading is where the center of the ball lines up with the gradation lines marked on the tube. Level indicators may have red and green zones only, or red, yellow, and green zones.

Correct Reading of this example indication is 6 degrees.

You can still operate safely even if your device is not perfectly level, but only if you keep it within the safe limits as indicated on the load chart for either the green or yellow zone. Do not operate with either the front-to-back or side-to-side level indicators in the red zone.

Avoid operating your ladder in a condition where the ladder rungs are not level to the earth as this will make climbing more difficult.

Level Indicator Reading		Working Zone
Front-to-Back	Side-to-Side	
Green	Green	Green
Green	Yellow	Yellow
Yellow	Green	Yellow
Yellow	Yellow	Yellow
Yellow	Red	Red
Red	Yellow	Red
Green	Red	Red
Red	Green	Red
Red	Red	Red

Level Indicator Reading

Short-Jacking

Your apparatus may allow for partial extension of the stabilizer arms (short-jacking). This capability allows your apparatus to be set up in an area where obstructions or surface condition do not allow them to be extended completely on one side.

Set up the apparatus so that the stabilizers can be sufficiently extended in the direction that you will be working and extend them as far as possible on the opposite side. If a stabilizer beam is not extended far enough to achieve a load rating, you will not be able to safely rotate the device over that side, unless your aerial device is equipped with the Alley Jack function. Whenever possible, a safety officer should observe aerial operations when you are using short-jack procedures.

OPERATING YOUR AERIAL SAFELY

Primary Control Operator

Operation of your aerial requires a qualified operator to be stationed at the primary controls on the turntable of the device at all times. You must also have a qualified operator at the controls any time there are personnel on the device, even if the device is not moving. The primary operator must be thoroughly trained, experienced and authorized by your department to perform primary control operation. A primary operator at the turntable controls is responsible for the safety of the operation, and is there to make immediate changes as needed to avoid imminent or changing hazards such as:

- Heat.
- Flames.
- Wind speed.
- Icing conditions.
- Wind and smoke direction.
- Power lines.
- Structural obstacles.

Secondary Control Operator

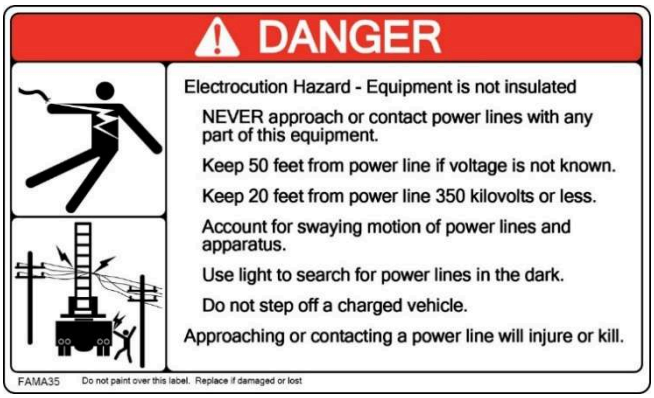
Your apparatus may have secondary controls at the tip of the ladder or at the platform bucket. These controls are only meant to be used with an authorized operator still at the primary controls. The primary operator must be prepared to override the tip or platform bucket operator if unsafe conditions are encountered. Both operators should be in communication with each other and with other personnel on the device at all times. If your apparatus is not equipped with a platform, keep the aerial ladder extended and use the fold-down steps with toe-guards and keep your fall protection tether secured to the device.

Use of a Spotter

During operation you may find that you are not able to see clearly through smoke or fog, or due to obstructions located on the far side of the device from where the controls are positioned. In situations such as these, you must use a spotter. Agree upon and train using standard verbal commands and visual signals until the team can perform operations safely and efficiently. If multiple spotters are required to ensure that all blind spots are covered, practice methods of ensuring that only one spotter at a time is giving directions.

Avoid Overhead Power Lines

Power lines are everywhere, and they present an extreme hazard to you and your aerial device. Unlike utility bucket trucks, your device is not insulated and will conduct electricity. Electrical arcs will burn, maim and kill you and others on or around the device if you get too close to them.



- Look up and Live. Always watch for power lines overhead.
- If operating at night, use powerful lights to search for power lines or poles.

- Stay 20 feet from power lines less than 350,000 volts.
- Stay 50 feet from lines over 350,000 volts or if the voltage is not known.
- Account for the swaying or bouncing motion of both the power lines and the device.

Extra Precautions Around Power Lines

If your apparatus is being operated around power lines you must take extra precautions. If the apparatus contacts a power line it will be electrified and the current will seek a path to the ground. If you are standing on the ground and touching the apparatus at the same time, you will be electrocuted. It is safer for you to be either completely on the apparatus, or completely off it and not touching it. If your apparatus includes a pump, it will have a pump operator platform. Always stand on this platform while operating the pump so that you will be safer if your apparatus becomes electrified.

If Your Device Becomes Electrified

If you are on or inside a vehicle that becomes energized by a power line, stay where you are. Exiting the vehicle is more hazardous than remaining on it. Stay in or on the vehicle until a power company representative informs you that the line has been de-energized, grounded, and that the area is safe.

If it is critical that you leave the vehicle, JUMP as far away as possible, landing with both feet together. Maintain balance or fall forward; don't fall back towards the vehicle which could result in your body becoming a pathway between the vehicle and the ground. No part of your body should touch the vehicle and the ground at the same time.

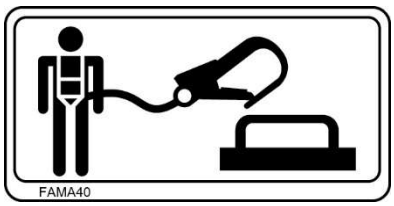
If you are outside of the vehicle that contacts or is energized by a power line, move away from the vehicle, and stay away. Warn others to stay away.

Rungs Aligned

Before allowing personnel to climb a telescoping aerial ladder or the ladder section of an elevating platform, you must ensure that the rungs are aligned. This will allow personnel to maintain proper foot angle while climbing and avoid the possibility of their feet getting caught between misaligned adjacent rungs. Your controls will indicate when the rungs are properly aligned for climbing. Always observe your ladder rungs directly to ensure that they are aligned.

Fall Protection

Any time you are climbing your device or operating from the platform bucket you must be wearing a ladder belt and tether or other approved fall protection PPE. The belt or PPE should be properly sized to fit you, and the length of the tether should be selected by the fire department safety officer based on your department's procedures.



If you are operating from inside the platform bucket, tie off to a fall protection anchor indicated by this symbol:

If you are on the ladder, tie off to a structural feature of the ladder such as a rung that will not allow the tether hook to slide downward. Do not tie off to non- structural features such as wires, cables, lights, brackets, etc. You must be tethered to a structural feature of the ladder or platform bucket any time:

- The device is in motion.
- You are not actively entering or exiting the platform bucket.
- You are not actively climbing or descending the ladder (If you stop at any point during your climb, connect your fall protection to a ladder rung.)

Climbing the Aerial Ladder

The National Institute of Occupational Safety and Health has considered the aspects around determining the optimum ladder elevation for climbing. NIOSH points out that there are several variables that must be considered when positioning an aerial ladder. One of these variables is the angle of elevation that is best for climbing. Steep angles of climb, even when kept within accepted standards, can make climbing and tool carrying more difficult for some persons.

Choosing an optimal climbing angle may require more than simply implementing a 1:4 or 75 degree angle “rule”. This rule has been derived from OSHA standards that may not account for to the heights firefighters may climb nor the bulk, weight and positioning relative to the body of the tools that they carry. Firefighters’ tools, PPE and SCBA place burdens on the body that should be considered. Adjust your angle of climb accordingly to minimize stress on climbers and allow them to maintain balance during the climb.

Use three points of contact and grasping the rungs as you climb. Grasping the rungs has several safety advantages over holding onto the rails:

- Your hands have more holding power when they are grasping a round bar than when they are grasping a rectangular object.
- If your feet slip and you are holding onto the rails, your hands may slide down the rails, and you may fall. If you are holding on to the rungs, it is more likely that your hands will have enough grip force to help you recover.
- If your feet slip and you are holding onto only one rail at the time, the weight of your body will be offset from your line of grip and your body will twist. If you are holding onto the rung, your grip force is lined up with your body, and your chance of staying in control is much greater.

There are four times as many falls from descending as from ascending a ladder. Pay close attention to your footing on the way down.

Water Towers

Your apparatus may be equipped with a water tower boom that is not equipped with a ladder and not designed to carry people. Keep personnel off the apparatus during any boom operation. The boom is designed for fire suppression only and is not designed nor equipped for carrying people. Do not climb or ride on this equipment, and do not allow others to do so.

- Do not climb or ride on boom
- Do not lift people
- Do not lift objects

Boom Style Platform

Your apparatus may be equipped with a boom-style platform bucket that is not equipped with a ladder and not designed to carry people. Keep personnel off the boom during operation. The boom is designed for supporting the platform bucket only and is not designed nor equipped for carrying people. Do not climb or ride on the boom, and do not allow others to do so.

- Do not climb or ride on boom
- Do not lift people
- Do not lift objects

Wire Rope Hazard

Your aerial device uses wire rope (cables) to extend and retract the ladder. Anywhere wire rope comes close to or contacts other mechanical parts such as pulleys, sheaves, roller guides or structural features on the device, a pinch hazard may exist. Anyone operating, climbing on, or supervising others on an aerial device that uses wire rope should study the wire ropes and follow these safe practices:

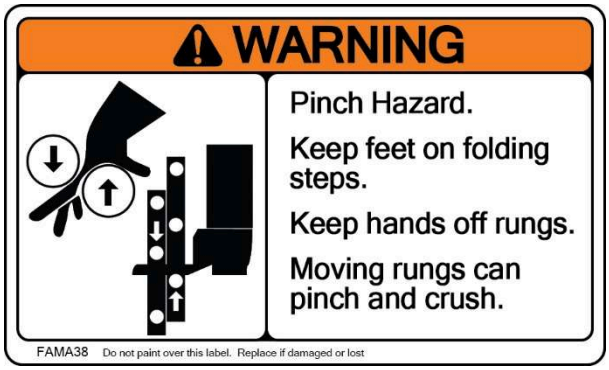
- Stay clear of wire rope, pulleys, and sheaves during operation.
- Never touch wire rope while someone else is at the control or during operation.
- Never touch wire rope while in tension or under load.

Operating with Personnel on the Aerial Ladder

You must never allow personnel to climb, ride or work on your aerial device unless they are thoroughly trained in safe operation and the importance of using the three points of contact method of climbing. Make sure that when people are climbing while carrying equipment that they have such equipment in their pockets or tethered to themselves in a way that allows them full use of both feet and both hands.

Before allowing climbers ensure that the ladder will not move. Do this using one of the following methods (depending on device design)

- Stand away from the controls
- Lock the system using the system lock
- Remove your foot from the operator presence foot switch
- Depress the Emergency Stop button



Never extend or retract the ladder with people on the ladder unless they are at the secondary operator station at the ladder tip and their feet are securely on the supplied folding step(s). Never retract the ladder past where the section

overlaps the secondary operator position. Extending or retracting the ladder with climbers on the ladder will crush their hands or feet. Never rotate, raise, or lower the device unless personnel are secured to a structural feature with a ladder belt and tether.

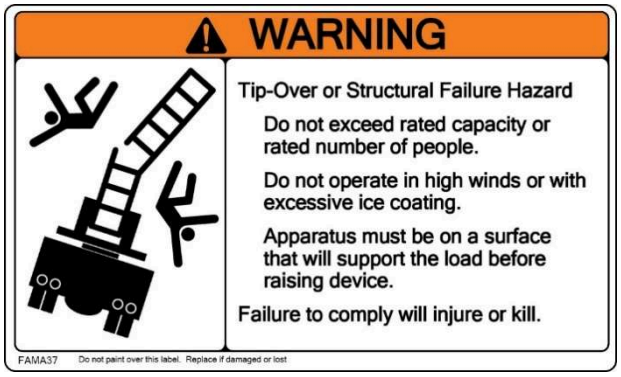
Ladder Base Pinch and Crush

Your aerial device is made from heavy structural parts that are constantly moving past each other during operation. This creates dangerous pinch or crush hazards all around you. You must study your device carefully and keep yourself and others well clear of these areas during operation. Never allow people to hold onto or lean against the device while they are waiting for you to position it.

Operating with Personnel near the Aerial

There may be times during operation when other personnel are working in the same vicinity. Instruct and train your department personnel that they should approach a working aerial device apparatus only after getting the all-clear from the primary control operator. Keep personnel clear of swinging structures and other moving parts. Keep them away from the area beneath the device and from around the apparatus. Items accidentally dropped by personnel on the device may injure or kill those below. Falling items may bounce off the ladder, turntable or other parts of the apparatus and strike personnel at some distance from the apparatus. Take extra precautions during icing conditions to keep personnel from being injured by ice falling from the device.

Operating within Safe Limits



Your aerial device will have a load chart that is specific to your device make and model and will be located near the primary operator station. You must study and memorize your load chart so that you will not need to refer to it constantly during operation. The load chart criteria should be so familiar that you can instantly recognize when the device is nearing a critical or overload condition.

Your load chart will tell you how many people you can have in various locations on the device depending on the elevation of the device, whether you are flowing water or not, and whether you are leveled within the green or yellow zones. Your device can support more people as the angle of elevation increases.

The safety of your operation also depends on factors that cannot be measured precisely and may change rapidly including:

- Level condition - Green, Yellow (If provided), or Red Zones.
- Monitor water flow and direction.
- Wind speed
- Wind gusts
- Ice build-up

You must be familiar with conditions that will reduce the capacity of your device and stay alert to changes in these situations.

You should always operate the device slowly, carefully and cautiously. Keep in mind that the load ratings on the chart are static ratings. This means that they assume only the weight of the personnel or equipment is acting on the device without bouncing or other sudden changes. Dynamic loading may be much higher than a static load. Do not allow personnel to bounce, swing or jump onto the device.

Load Chart Limits and People on the Ladder

Your load chart will indicate the maximum number of people that can be placed on each section of your ladder depending on the position of the device. Never exceed these limits.

Over 250 Counts for Two - the load chart is valid only if each person does not weigh more than 250 lb. (113 kg) including clothing, gear, etc. If you have a person on your device who is significantly heavier than this value you must adjust accordingly. For persons who are heavier than 250 lbs, count them as if they were two people. FAMA studies have shown that the average firefighter with PPE and SCBA weighs 250 lbs. NIOSH studies suggest this value may be even higher. Take the time to weigh your personnel in PPE, SCBA, and the equipment they will have while climbing so you know when to adjust for heavier personnel.

One Person One Rung - the load chart assumes that people on a ladder are never sharing a rung. Keep your climbers spread out appropriately.

Approaching Structures

Your aerial device is designed to handle loads in the downward direction only. It will be damaged if it is loaded by resting the tip on a structure, powering it down onto a structure, powering it into the ground, or by using it to span a structure like a bridge. It may also be damaged if it is rotated into a structure. Never use it as a battering ram to knock over structures, break windows, or for any purpose other than fire suppression or rescue operations. Never push or pull sideways on your aerial device. Do not use it as a crane.

During rescue operations, always aim the tip of your device above the victim and the structure and slowly lower toward the target. Stop the device six to 12 inches above the target. Personnel weight on the device will then cause the device to settle onto or just above the structure without risking a reverse-loading condition.

Operating above Structures

There are times when you may wish to extend your aerial device over the top of a structure. Do not do this if there is a risk of a flashover or sudden roof ventilation. You should never position the device over high heat or open flame as exposure to high temperatures will weaken structural members, melt wires and hoses, and present a hazard to personnel on the device.

Icing Conditions

If you are operating your aerial device in freezing temperatures, you must be alert to the possibility of ice forming on the device. This can happen from freezing fire streams, freezing rain, freezing fog, or snow that melts and then re-freezes. You must use extreme caution when retracting or extending an aerial device that is coated with ice, both for the safety of personnel and to protect the device from damage. Keep personnel clear of the path of falling ice. Move the device slowly to allow ice to fall away.

Inspect the device thoroughly after operation in an icing condition as the operation with an ice coating can damage many components of the device and render it unsafe for future use.

Windy Conditions

High winds can tip over any aerial device. See your load chart to determine what wind speed your device is rated for. You must then select a method that you will use to determine the wind speed while you are operating. The best method is a wind speed indicator mounted at the tip of the device. You can estimate wind speed in an emergency using the Beaufort Scale if your wind speed indicator quits working or is unavailable.

Wind speeds usually increase the higher up you climb, and the wind speed at the tip of the device will have the greatest over-turning impact. Retract and stow your device before the wind conditions increase above the wind speed rating.

Just because your device is rated for a certain wind speed does not mean it is safe for people to be operating on the ladder or in the platform. High or gusting winds will be a hazard to climbers and people in a platform bucket. Consider removing people from the device in high winds and using the device for water delivery only.

Beaufort Number	Wind Speed (mph)	Description	Land Conditions
0	0	Calm	Calm. Smoke rises vertically.
1	1-3	Light Air	Wind motion visible in smoke.
2	4-7	Light Breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle Breeze	Leaves and smaller twigs in constant motion.
4	13-18	Moderate Breeze	Dust and loose paper raised. Small branches begin to move.
5	19-24	Fresh Breeze	Smaller trees sway.
6	25-31	Strong Breeze	Large branches in motion. Flags waving near horizontal. Umbrella use becomes difficult.
7	32-38	Near Gale/Moderate Gale	Whole trees in motion. Effort needed to walk against the wind.
8	39-46	Fresh Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Strong Gale	Light structure damage.

Beaufort Scale (For Reference Only)

Flying Flags

Your department may wish to use your aerial apparatus for tasks it was not designed for. Any use other than fire suppression or emergency rescue is not recommended. Flying flags, for instance, is a popular practice, but the forces imposed on your device are unpredictable and may exceed the load chart ratings. The risk increases as the wind speed and variability increases. Your safety officer should study any such practice carefully and take responsibility for the safety of the apparatus and for personnel in the area. Never exceed the load chart ratings.

Lightning Threat

Your apparatus will not protect you from lightning strikes. To avoid the risk of death or injury, retract your device and seek shelter before lightning storms enter your area.

Rope Rescue

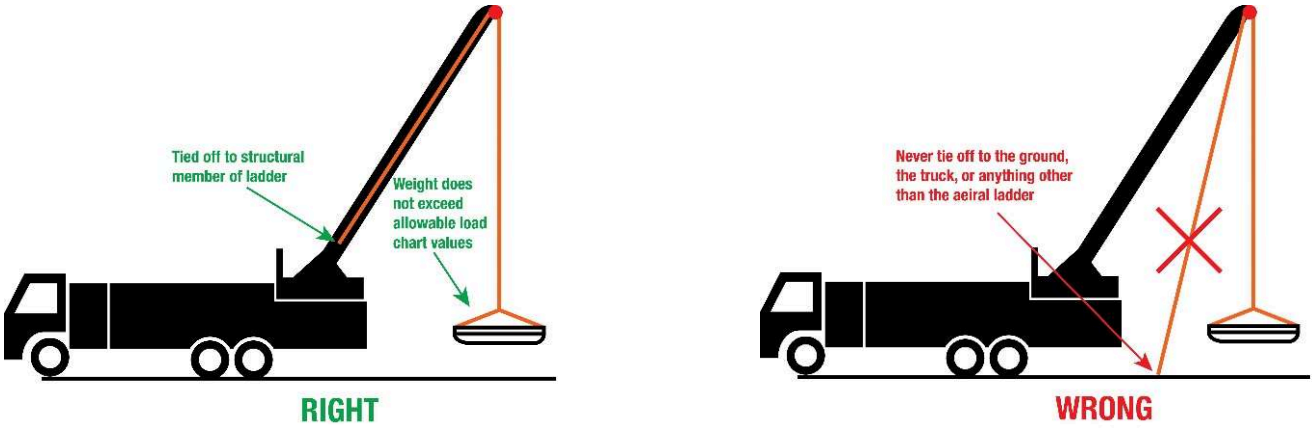
Your aerial device may be equipped with a feature to facilitate rope rescue operations. The top portion of this feature may be an anchor point on your platform bucket, or a pulley device that attaches to the tip of your ladder. The bottom portion of this feature may be a fixed tie-off appropriately labeled near the base of the ladder, or a Change of Direction Bar that attaches to the ladder near the base of the ladder. Only use these provided features and/or devices to perform rope rescue with your apparatus.

Your apparatus is not a crane, and it is not designed to be used as such. Refer to your apparatus load chart. The weight that you lift should never exceed the load chart ratings, and it should never exceed the rated capacity indicated on the rope rescue anchors or change of direction bar. Anchor points or devices provided with your apparatus are intended to be used as a single anchor for a single rescue rope only.

To ensure that the capacity is not exceeded, it is essential that you lift in a smooth manner, without causing the device or the load to bounce, jerk or sway. Use appropriate methods to stabilize the load while it is being lifted.

If you are using the pulley provided for rope rescue, or if you have attached a single pulley to the anchor on your platform bucket, the working end of the rope must follow along parallel with the ladder to the turntable anchor, or be passed through the Change of Direction Bar pulley properly attached at the turntable. In this configuration, the rope will be raised when the device sections are extended and lowered when the device sections are retracted. Never use additional pulleys or block and tackle as the load on the device will be multiplied.

The working end of the rope should never be anchored to other parts of the ladder, other parts of the apparatus, static structures, or to objects on the ground. If the rope is anchored to a point that is not in-line with the ladder, the load on the device will be doubled and you will exceed the ratings and overload your aerial device. Overloading will risk device damage, tipping or collapse leading to injury or death.



Proper rigging for rope rescue, attachment of ropes to rescue baskets, and all other operations involved in rope rescue other than those outlined in this manual are the responsibility of you and your department. Guidelines that you may find useful when determining how to safely perform rope rescue operations with your apparatus include:

- **NFPA 1983** *Standard on Life Safety Rope and Equipment for Emergency Services.*
- **NFPA 1670** *Standard on Operations and Training for Technical Search and Rescue Incidents*.
- **IFTSA** *Fire Service Technical Search and Rescue manual.*

Positionable Waterway Monitor

Your device may be equipped with a pre-piped waterway that allows the monitor to be positioned at the tip for fire suppression, or on a lower section for rescue. If your device includes this feature, it is essential that you always be sure that the monitor is secured in its anchor. If water pressure is applied when the monitor is not securely anchored, the pressure will cause the waterway to extend rapidly on its own. The rapid movement of the pipe sections can damage equipment or harm people who may be on the ladder at the time. Study the waterway on your device, understand the monitor anchoring mechanism, and always be sure the monitor is secured prior to charging the waterway.

Aerial Ladder Pipe Operation

Your department may choose to use a ladder pipe nozzle supplied by a fire hose that you lay along the ladder rungs. Only use this method with extreme care and under the supervision of trained personnel who understand the extra loads created by the weight of the hose and the reaction forces of the nozzle. Use only ladder pipes designed for the application and follow all ladder pipe manufacturer operator instructions and fire industry best practices.

Lay the hose along the middle of the ladder so that it rests on the rungs only. Tie off the hose so that it stays in the middle of the ladder when charged. Never hang the hose off the side of the ladder. Never use more than one ladder pipe nozzle and hose on your aerial ladder. Do not use an aerial ladder pipe and fire hose on an apparatus that is equipped with a pre-piped waterway and water monitor.

TRACTOR DRAWN AERIAL OPERATIONS

Tiller Steering Lock

If your apparatus is a tractor-drawn aerial there are two ways in which the trailer can be towed, with the rear steering functional or with it locked. Always check the steering lock before placing the vehicle in motion unless you have a tiller operator at the wheel. Driving without a tiller operator while the steering is unlocked will cause the trailer to steer uncontrollably.

Never attempt to lock or unlock the steering with the apparatus in motion.

Tiller Steering

If you choose to operate your aerial tiller with the rear steering unlocked, you must have a tiller cab operator seated and belted prior to placing the apparatus in motion. The tiller operator must be alert at all times to keep the trailer tracking behind the tractor, or to avoid traffic and other road hazards.

Tractor Operator Training

Obtain a Class-A Commercial Driver's License or the equivalent fire department training and authorization prior to driving from the tractor position. This training must include the special aspects of driving a heavy combination vehicle.

Tiller Operator Training

The tiller operator must be trained, experienced, and authorized to occupy this role. Training should be conducted under supervision and in a controlled location.

Tiller Cab Safety

When operating from the tiller cab, follow the same safety procedures that you would follow if you are driving from the tractor (see Riding Safely and Driving Safely in this manual) including the following:

- Seat Belts: Seat belts in good condition. Seated and belted prior to vehicle motion.
- Seat Adjustment: Seat adjusted to allow proper reach of operational controls.
- Doors: Doors fully closed and latched
- Helmets: Helmet off and secured for travel
- Equipment Secured: No loose equipment in the cab.
- Mirror Adjustment: Mirrors and/or cameras adjusted properly
- Visibility Check: Glass clean and free of fog or ice, wipers operational, defroster operational.

Fifth Wheel Lock

Your tiller aerial apparatus may include a feature to lock the tiller trailer turntable connection (fifth wheel) from articulating up and down. It does not lock the connection from rotating. This locking feature is critical to providing

stability while the ladder is being operated. This lock allows the weight of the tractor to contribute to stability. If you attempt to operate the ladder without the fifth wheel locked, the ladder could tip over.

The fifth wheel must be unlocked before moving your apparatus. Driving your apparatus with the fifth wheel locked would cause uneven loading on the axles. This could lead to serious driving hazards including reduced steering control, reduced braking control, and poor handling. Never place your apparatus in motion unless the fifth wheel is unlocked.

ELECTRIC FIRE APPARATUS

High Voltage Hazard

Your vehicle may operate on high voltage electric power rather than, or in addition to, diesel or other fuel. Exposure to high voltage can cause shock, burns, and even death. The high voltage components in the vehicle can only be serviced by technicians with special training.
Do not remove, open, take apart, or modify high voltage electric components.
High voltage cable or wiring has orange covering. Do not probe, tamper with, cut, or modify high voltage cable or wiring.

First Responder Cut Loop

Your electric fire apparatus will have a First Responder Cut Loop of wire located behind a panel. In the event of a crash or other emergency the wire loop can be cut with a side-cutter, knife or other cutting tool. Once the wire has been cut the high voltage electricity should be contained within the high voltage battery housings. This will reduce the possibility of electric shock when working around the vehicle during an emergency. Follow your vehicle manufacturer's operator manual instructions for safe battery disconnection during service and maintenance situations.

Emergency Response Guide

Your electric fire apparatus will have an Emergency Response Guide. This guide is intended to provide all the information that a first responder will need if your apparatus is in a crash. Study the Emergency Response Guide and share it with other first responders in your department or in your response area.

PERFORM MAINTENANCE SAFELY

Maintenance Records

The safety of your apparatus will depend on how well it is maintained, and good maintenance depends on keeping accurate maintenance and repair records. Maintenance and repair records should be maintained as permanent records and kept in a secure location. Acceptable records include itemized bills, dealer work orders, owner's vehicle log, and service facility receipts, stating the date service was performed Vehicle Identification Number (VIN), mileage (kilometers), engine hours, and service performed.

Consult NFPA® 1911: *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus* for apparatus inspection and maintenance recommendations.

Use OEM Parts for Repair

Your apparatus is designed to operate as a system. Every part has been selected to ensure proper performance. While some common service parts such as fluids and filters may be available from heavy truck supply sources, purchasing repair parts from any place other than your authorized dealership may put the safety or performance of your apparatus at risk. All safety-critical components should always be sourced through your authorized dealer including:

- Chassis structural components.
- Chassis steering, suspension, and brake components.
- Apparatus related electronics.
- Aerial and stabilizer hydraulic cylinders including valves and manifolds.
- Hydraulic rod-end pins, hardware, and locking devices.
- Ladder or boom slide pads.
- Aerial extension cables, sheaves, and anchors.
- Turntable rotation bearings, rotation gears, drive gears, and motors.
- Rotation sensing components (proximity switches, encoders, limit switches, etc…).
- Extend or retract sensing components (proximity switches, limit switches, etc…).
- Stabilizer extension sensing components (proximity switches, limit switches, etc…).
- Jack plant sensing components (proximity switches, limit switches, etc…).
- Wire harnesses and connectors.
- Wire bulkhead connector or other pass-through component for wires entering rung rails or hand rails.
- Corrosion inhibitor material for the interior of aerial ladder structural tubes.
- Mounts for securing equipment on the device (pike poles, roof ladders, etc…).
- Safety signs, load charts, and other instructional material.
- Hydraulic tubes, hose assemblies, fittings etc…
- Hydraulic valves, velocity fuses, filters, manifolds, solenoids, etc…
- Rotation swivel and associated components.
- Waterway including mounting brackets and seals.
- Cable tracks, raceways, and associated components used to guide cables and hoses (igus or similar).
- Rung covers.
- Aerial control valves, switches, levers and joysticks.
- Aerial motion control computing devices (plc or similar).
- Aerial remote control receivers, transmitters, controls pads, tethers, and associated equipment.
- Optional equipment such stokes basket mounts, rope rescue pulleys and anchors parapet ladders, etc…
- Fall protection anchors.
- Platform basket components including doors, gates, latches, handrails, etc…
- Stepping, standing, and walking surfaces.
- Access ladders and handrails.

Running the Engine

Unless a maintenance routine specifically states otherwise, turn off the engine and all other equipment prior to performing maintenance tasks.

Preparing for Maintenance

Remove all jewelry prior to working on your apparatus. Metal jewelry is a conductor and can cause burns if in contact with electrical power, and other injuries if worn while performing maintenance. Rings can get caught on projections leading to loss of fingers. Hanging jewelry can get caught in moving machinery.

Always use appropriate PPE including gloves, eye protection, hearing protection, safety shoes, and protective headwear when working on your apparatus.

Depressurize air, hydraulic and cooling system lines prior to removing or replacing components.
Ensure working areas are free from oil, grease, and foreign materials.

Compressed Air for Cleaning – DO NOT USE

The use of compressed air for cleaning is not recommended. Using compressed air for removing debris creates an environment of propelled foreign particles, which can cause injury to personnel.

Chemicals and Cleaners

- Use only non-flammable solvents for cleaning component parts.
- Keep chemicals and cleaners in approved safety containers and in minimum quantities.
- Use approved protective equipment and clothing, such as gloves, apron, and eye protection, when handling chemicals and cleaners. Some chemicals have an adverse effect on skin and eyes.
- Ensure adequate ventilation when using chemicals and cleaners. Some chemicals have an adverse effect on the respiratory tract.
- Observe all manufacturers manuals, warning labels and current safety directives.
- Use chemicals and cleaners in authorized areas only.
- Dispose of all soiled clothes and materials in accordance with national and local directives for hazardous waste.

Decontamination Chemicals

Decontamination chemicals that contain hydrogen peroxide (such as Decon7) should be used with caution and strictly following the manufacturer's instructions. Hydrogen peroxide is an oxidizing agent that will cause corrosion when applied to bare metal. It will also damage exposed electronics. Follow these guidelines:

- Apply in the cab interior as a fine fogging mist only. Do not spray directly on bare or unfinished metal surfaces, or painted surfaces that have been scratched or marred.
- Do not spray or foam on switches, gauges, display screens, or other electrical or electronic devices.
- Remove accidental over-spray using water and a clean cloth.

Always follow the manufacturer's safety recommendations while working with decontamination chemicals including:

- Use only EPA registered products
- Avoid breathing mist or vapors
- Wear Gloves (resistant to chemical products [butyl rubber, nitrile and neoprene, polyethylene, polyvinyl chloride])
- Wear protective clothing
- Wear eye protection (face shield or safety glasses)
- Wear Respiratory protective equipment (air respirator or SCBA)

Tilting the Cab

Always ensure that the vehicle is on a flat and level surface before tilting the cab. Tilting the cab on an inclined or non-flat surface may produce interference between components as the cab is lowered. Before tilting cab:

- Check the front bumper and bumper extension to ensure that covers are shut and plumbing swivels are rotated forward. Remove all loose items from the cab as contents may shift or drop.
- Close the crosslay cover and stow any other body related feature that hangs over the cab.
- Raise any aerial device if located over the top of the cab.
- Ensure that there is clearance above the cab and the area is clear of power lines.

Always check to make sure that people working on or around the cab are clear before raising or lowering the cab.

Immediately after raising ensure that the stay-arm or mechanical support is secured in the support position. Hydraulic cylinders can leak or drift and should not be relied upon to support the cab on their own.

If the cab fails to lower after following the proper instructions, do not attempt to force it. Have the system checked by a qualified technician and refer to the cab tilt system instructions in the service manual.

Lock-Out Tag-Out

You may come across an apparatus in your facility with a sign that says Lock-Out Tag-Out (LOTO) on it, or you may need to perform work where LOTO procedures are required. LOTO is the procedure used for preventing the unexpected release of hazardous energy while servicing and maintenance activities are performed.
Never operate a vehicle or equipment that is marked with LOTO devices. Always use LOTO procedures as required; failing to do so may expose you to hazards associated with hazardous energy sources. Follow your department procedures, which should conform to OSHA 1910.147 regulations.

Access Features not Provided

Your apparatus may have methods to access equipment or machinery for service or periodic maintenance. These areas may or may not be equipped with a means of access that allows three points of contact at all times. If it is necessary to climb onto, into or around portions of your apparatus that are not equipped for three points of contact, special accommodations must be made for safe access in a controlled, service environment. Use overhead safety harnesses and tethers, step ladders, access platforms, scaffolding or other means to ensure that service and maintenance personnel are protected from stepping, standing and climbing hazards.

Confined Space

Your apparatus may contain spaces such as water tanks that are considered to be “confined” because their configuration hinders the activities of employees who must enter into, work in or exit from them. In certain instances, employees who work in confined spaces also face an increased risk of exposure to serious physical injury from hazards such as entrapment, engulfment and hazardous atmospheric conditions. Confinement itself may pose entrapment hazards, and work in confined spaces may keep employees closer to hazards such as

machinery components. Limited access and restricted airflow can result in hazardous conditions that would not normally arise in an open workplace.

OSHA's standard for confined spaces (29 CFR 1910.146) contains the requirements for practices and procedures to protect employees, in general industries, from the hazards of entering confined spaces. Evaluate your apparatus to determine if there are confined space hazards and take proper precautions before working in a confined space. Use lock-out /tag-out procedures where appropriate.

Welding

Your chassis has a high-strength steel frame rails that should not be welded on unless you are following a specific factory authorized repair procedure. Welding on your chassis frame in any manner not prescribed by the factory may result in serious structure failure.

Your apparatus includes electronic components that can be damaged from the high voltage and current generated during the welding process leading to apparatus failure. Disconnect electronic devices prior to welding on your apparatus including:

- Bosch or WABCO ABS ECU
- Cummins Engine ECU.
- Allison Transmission Control Module (TCM).
- Foam Pro foam system ECU, pump, and gauge connections
- Flasher modules
- Side Roll and Frontal
- Occupant Protection system ECUs
- Multiplex system modules.

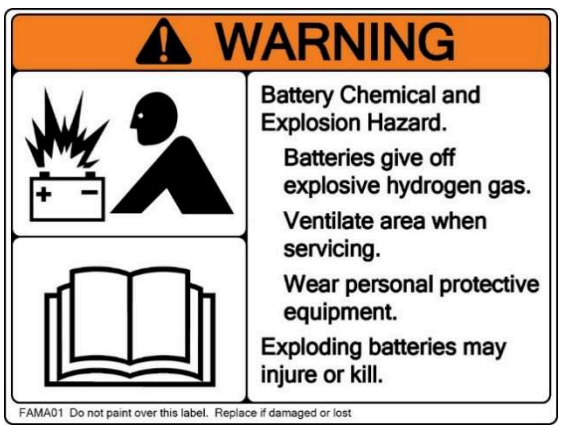
Do not weld on galvanized frame rails or other galvanized components as serious adverse health reactions may result.

Interlocks

Your apparatus may include protective interlocks that modify or prevent certain functions. These interlocks were designed into your vehicle for your safety and the safety of your operators. Never place an apparatus back in service unless all factory interlocks have been restored to their proper function. Never bypass a safety interlock device.

Batteries

Always wear safety goggles and protective clothing when working on or around batteries. Do not check battery condition by shorting across terminals. Inhaling hydrogen gas produced by the normal operation of the battery could result in partial or permanent damage to the respiratory system. Battery posts, terminals and related accessories contain lead and lead compounds — chemicals known to cause cancer and reproductive harm. Wash hands after handling.



Before servicing batteries on your apparatus, become familiar with safe handling techniques. Batteries give off hydrogen gas

that is highly explosive. Keep all sources of ignition away when working around batteries, including matches, lighters, and cigarettes. Sparks caused by connection of battery terminals, jumper cables or charging systems can be a source of ignition.

Whenever disconnecting battery terminals, always disconnect the ground terminal first. When reconnecting, always connect the ground terminal last. Do not attempt to jump-start a vehicle having a frozen battery because the battery may rupture or explode. If a frozen battery is suspected, examine all fill vents on the battery. If ice can be seen, do not attempt to start with jumper cables. Thaw out battery before jump-starting or recharging.

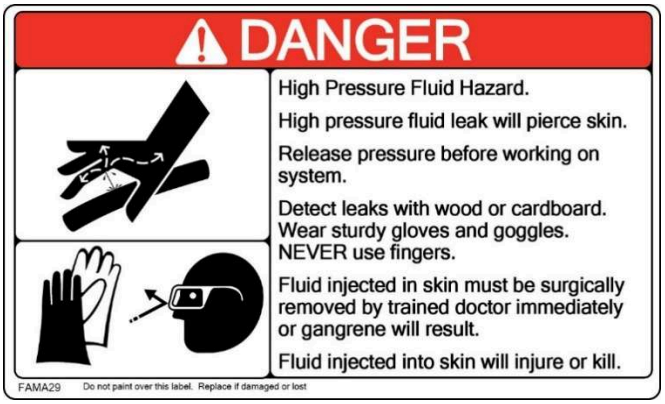
Battery Charging

Never disconnect a battery while charging: this could cause sparks.
Do not use battery charging equipment in the rain, in areas used for washing or in damp areas.
Gases generated during charging are explosive. Do not smoke in the vicinity of the batteries. Use battery chargers only in well ventilated areas.

Before starting to charge, make sure the voltage of the equipment suits the voltage of the battery, that the charging current suits the capacity of the battery and that the selected charging curve (for lead-acid batteries or airtight gel batteries) is correct for the type of battery to be charged. In addition, make sure the rated input voltage of the charger suits the available supply voltage and the system is equipped with grounding.

High Pressure Hydraulic Fluid

Your apparatus develops high pressure fluid in the fuel lines of your engine. You may also have features powered by high pressure hydraulic fluid. If you see or suspect a fluid leak, shut down the equipment and call a service technician trained in safe methods of troubleshooting and servicing high pressure equipment.



Never search for leaks with your hands or other body parts. High pressure fluid can penetrate skin. Use a piece of wood or cardboard to detect leaks, keeping hands and other body parts well away from the potential source of the leak.

If you suspect that you have been exposed to high pressure fluid through skin penetration, seek medical help immediately. The high-pressure injection of a fluid such as fuel, hydraulic oil, grease and paint constitutes a medical and surgical emergency, requiring access to appropriate, surgical specialists as soon as possible. Often, the injury appears minor; don't be fooled. Fluids injected under the skin are highly toxic. The injury will lead to gangrene, amputation or death if not treated promptly.

Aerial Device Equipment Mounting

Anything mounted on your aerial device subtracts from the load capacity. Your load chart assumes that you have not mounted any additional equipment or modified the device in any way. Never add any equipment or mounting provisions that add weight to the device without written permission from this manufacturer.

Aerial Device Inspection

Your aerial device is a complex machine that requires constant care and thorough inspection. Study your aerial device's manufacturer's operation and maintenance manuals, the IFSTA Pumping and Aerial Apparatus Driver/Operator Handbook, and the **NFPA® 1910** *Standard for the Inspection, Maintenance, Refurbishment, Testing, and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels* to determine the critical points on the device that should be regularly inspected. Inspect these points and look for signs of wear, corrosion or impending failure. Critical points of inspection should include, but not be limited to:

- Pins.
- Cables (Wire Rope).
- Sheaves.
- Lighting.
- Cylinders.
- Wire Insulation.
- Wear Pads and Surfaces.
- Weld Joints.
- Electrical Cabling.
- Mounted Equipment.
- Slip Resistant Surfaces.
- Structural Members

Follow the **NFPA 1910** recommendations for annual inspection.

Radiator Cap

The radiator cap serves an important function. It holds the pressure of the cooling system so that coolant flows continuously through the radiator. You may need to remove the radiator cap on occasion to fill the radiator with coolant or to test the cooling system. Before attempting to remove the cap, allow the radiator to cool down completely. The cooling system is both hot and under pressure. At normal operating temperature, the coolant can reach several hundred degrees Fahrenheit, cause serious burns on your skin, or cause you to go blind if it gets into your eyes. To prevent splashing, cover the cap with a rag.

Seat Belt Inspection and Replacement

You should inspect the seat belt components of your apparatus regularly to ensure they will function properly in a crash. Webbing can be abraded, soiled, or torn more quickly in a fire apparatus than in your personal vehicle due to the heavy duty service they will experience. The entire seat belt assembly should be inspected for corrosion, wear, fraying, or weak spots. The retractor, latch and buckle should be checked for proper function, and all seat belt mounting bolts should be tight at all times.

Seat belt webbing should be considered for replacement at least every five years. Replace seat belts as a complete assembly. Replace any seat belt assembly that is exposed to a serious crash before the vehicle is placed back in service.
Do not bleach or dye seat belt webbing. Bleaching or dying may cause a severe loss of belt strength resulting in failure during a crash.

Inspect the seat belts as follows:

- Webbing should be free from frays, cuts, and excessive wear. Pay attention to the area near the buckle latch plate and in the D-loop guide area.
- Webbing should be clean, and not severely faded from exposure to the sunlight.
- Buckle receiver should slide together easily with a positive click when they latch.
- Sliding Komfort Latch® should operate properly.
- Seat belt retractor should retract the webbing completely with no or minimal assistance.
- All mounting bolts should be tight.

Side Roll or Frontal Crash Occupant Protection

Your apparatus may be equipped with inflatable occupant restraints (air bags), seat belt pretensioners, and suspension seat pull-down devices. These devices operate in a split second and are powered by pyrotechnic (explosive) charges. Never attempt to remove, modify, or repair any of these devices without the express permission and instructions from a factory representative. Tampering with or removing an inflatable occupant protection system sensor (the black box that controls the firing of the devices) can cause the devices to fire which may lead to injury or death. Consult the factory before attempting any removal, modification or repair of any air bag, air bag sensor, seat belt pretensioner, or suspension seat pull-down device.

Pyrotechnic devices can be dangerous if modified or removed. When activated in a crash or rollover they will exhaust harmless blue smoke. Never service, attempt to salvage, or reuse side roll or frontal protection components. Never weld or apply heat on or near side roll or frontal protection components. Never grind, puncture, or drill on side roll or frontal protection.

Information on all component caution and warning labels must be complied with. Labels are placed in visible locations on each component of the Side Roll Protection System. If labels have been removed or are not visible, please contact your customer service representative for the proper replacement labels.

After one of these systems has been deployed, the major components cannot be reused. The Suspension Seat Safety System (S4S), roll & slave sensor(s), Integrated Gas Pretensioners (IGP) / Integrated Belt Pretensioners (IBP), and Inflatable Head Curtains (IHC) / Supplemental Restraint Airbags (SRA) must be replaced. In addition, the wiring harnesses will require inspection and possible replacement. After all system components are inspected and/or replaced, the integrity of the system must be checked by an authorized technician. This service must be performed by a service facility authorized by customer service.

Suspension Seat Tethers

Your apparatus may include a suspension seat that uses a seat tether. Inspect each suspension seat and identify any web-type tether that connects the suspension seat to the cab floor structure. If the tether includes an adjustment feature, ensure that it is adjusted to allow full travel of the seat suspension only. The tether should be taut when the seat is adjusted to its full forward and upward excursion of travel.

Tire Inflation Pressure

Proper tire inflation is vital to the safety and performance of your apparatus and should be checked with an accurate tire pressure gauge only. Never reduce inflation pressure to attain a softer ride. Under-inflation causes excessive flexing within a tire, resulting in heat build-up which can cause a blowout. An under-inflated tire running at highway speeds and under heavy load can cause severe handling problems.

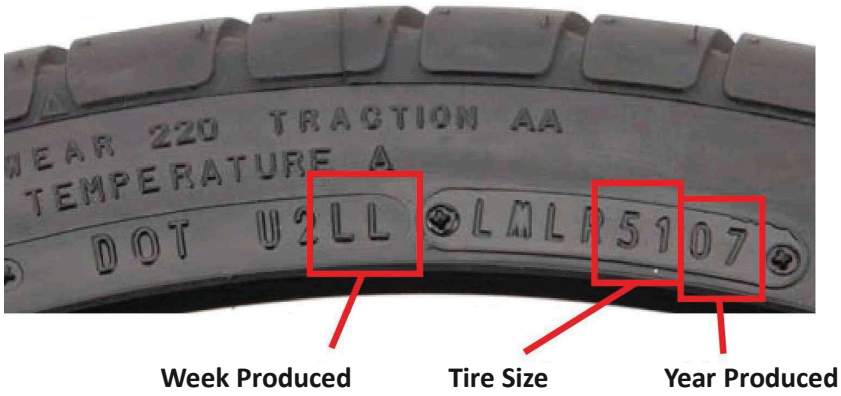
Tire Wear Inspection

Inspect tires for signs of abnormal or excessive wear. Sufficient tread depth is essential to proper handling and braking performance. Refer to the tire manufacturer's manual for minimum tread depth requirements. Replace tires before minimum tread depth is reached. Tire tread life is dependent on many factors including the following:

- Tire load.
- Brake power.
- Engine horsepower.
- Suspension alignment.
- Proper inflation pressure.
- Frequency of tight cornering maneuvers.
- Driving habits of acceleration and braking.
- Tire footprint (area of rubber in contact with the road).
- Tandem scrub (inherent to all non-steering tandem suspensions).
- Frequency of dry-steer maneuvers (steering the vehicle in the absence of forward motion).

Tire Replacement

Tire rubber degrades over time, even if the tire is not used. Replace your tires after they have been on the apparatus for more than seven years, even if the tread is still satisfactory.



The tires installed on this vehicle at the factory as original equipment are certified for compliance with federal greenhouse gas and fuel efficiency performance regulations. In order to maintain the same level of tire performance, replacement tires must be of equal or lower rolling resistance level (TRRL or CRR). Consult with your tire supplier(s) for appropriate replacement tires.

Manual Parking Brake Release (Caging the Brakes)

If your apparatus must be towed and sufficient air brake pressure is not available, the spring brakes will need to be manually released or "caged." Remember that caged brakes will not hold your apparatus from rolling. Never leave a vehicle with caged brakes unattended, park it on flat surface only, and chock the wheels in both directions before caging the brakes. Perform lock-out/tag-out to secure the vehicle and make sure no one drives it or removes the wheel chocks until repairs are complete.

Line-Voltage Components and Wiring

Your apparatus may be equipped with a line-voltage generator that produces high 120V, 240V, single or three-phase alternating current. Line voltage generators, components, wiring, and circuit protection should be maintained by qualified and authorized electricians trained in all aspects of the National Electrical Code (NEC) safety practices.

Disconnect power before removing any line voltage breaker box cover or junction box cover or working on line voltage wiring. Follow National Electrical Code safe practices. Electrical shock can injure or kill.

To avoid property damage, personal injury, or death, refer to the component manufacturer's service information before working on any high voltage equipment. By definition, high voltage circuits and components contain voltage levels that may cause equipment damage, electrical shock and/or electrocution if handled incorrectly.

All electrical circuits associated with Auxiliary Power Units (APUs), shore power, and inverters should be considered high voltage.

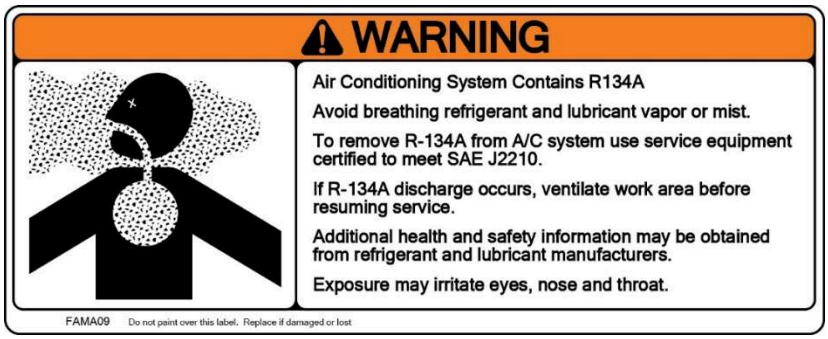
Shoreline Electrical Connection

Your apparatus may include an electrical connection to keep the batteries charged while in the station (commonly referred to as a shoreline connection). A compatible power cable is required to make this connection. It is essential that the source of power is the correct electrical phase, polarity, voltage and current capacity. Refer to the placard near the shoreline connection. Only connect the vehicle to a trusted source that you are sure meets these criteria and NEC and local electrical codes.

Wire Rope Inspection or Maintenance

Your apparatus may use wire rope (cable) that needs to be inspected or serviced. Wire rope, through use, can develop "barbs" which can slice skin. It is extremely important to wear protective gloves while handling wire rope. Avoid loose fitting clothes or anything that could become entangled in the wire rope and other moving parts.

Air Conditioning Refrigerant



Use only refrigerants approved for use in air conditioning systems. Some unapproved refrigerants are flammable and can explode, causing injury to personnel. The air conditioning system contains refrigerant under high pressure. To avoid risk of personal injury or damage to the system, only a certified technician should add refrigerant or perform any repair requiring lines to be disconnected.

Towing Your Apparatus

Only allow your apparatus to be towed by a trained, authorized, and experienced tow operator. Tow only with a sufficiently capable heavy duty wrecker. To prevent damage, injury or death;

- Do not lift apparatus from front bumper or front bumper extensions.

- Only lift apparatus from front axle, front suspension, or chassis frame rail or frame rail crossmember that is bolted directly to the frame.
- Disconnect the driveline or remove the axle shafts from the drive wheels.
- The wrecker operator is responsible for following all warnings associated with equipment, controls, and operation.

No-Spin or Locking Differentials

If your apparatus is equipped with a No-Spin or Locking Differential be sure to distribute the load evenly side-to-side; do not exceed the vehicle's rated payload capacity; keep the diameter of the tires equal. Failure to observe these measures can create a difference in individual wheel speeds which can cause the No-Spin or locking differential to deliver power to only one side of the vehicle and thus cause steering problems.

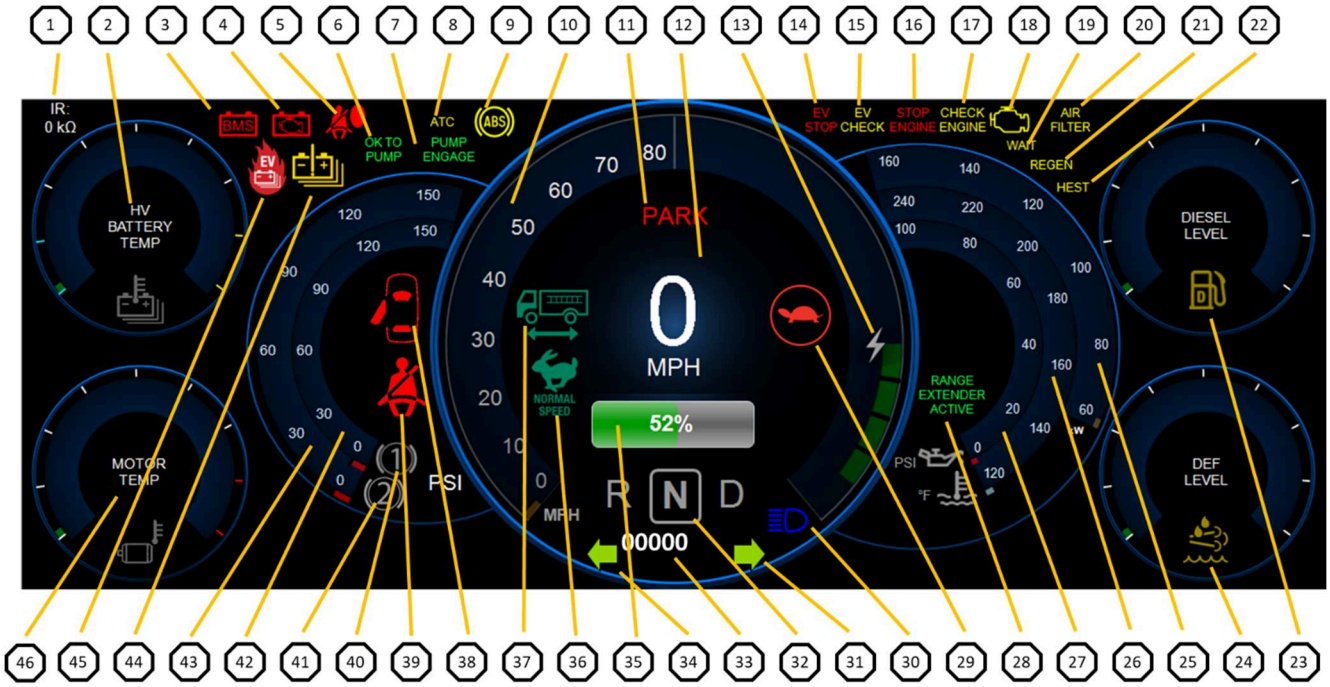
Turn the engine off and raise all driving wheels of a No Spin or locking differential equipped axle when changing tires to prevent the vehicle from moving. Axles equipped with No-Spin or locking differentials deliver power to both wheels - even when only one wheel is on the ground.

VEHICLE CONTROLS & COMPONENTS DESCRIPTIONS

OVERVIEW

The images and descriptions of controls and components in this manual represent typical apparatus construction. Due to the custom nature of fire apparatus, it is probable that some of the actual controls or components included on your apparatus may differ in appearance or location. If the differences are great enough to cause confusion, please contact your apparatus dealer representative or the factory customer service representative for clarification.

CAB DASH DISPLAY



Cab Dash Display

1. **High Voltage Isolation Resistance** - The High Voltage Component Isolation Resistance is a measure of how well the high voltage system is isolated from the chassis. This reading will not be accurate until it has settled for 5 minutes after turning POWER ON. Normal range should be between 200 and 400 (KΩ).
2. **High Voltage Battery Temperature** - Displays the temperature of whichever High Voltage battery cell is either the hottest or the coldest (most critical condition). If the batteries are warm, the gauge displays the highest cell temperature. If the batteries are cold, the gauge displays the lowest cell temperature.

High Voltage Battery Temperature

An ORANGE heat wave icon will appear inside the battery icon if the lowest cell temperature is in a range where the Battery Thermal Management System is working to warm the Electric Vehicle batteries.

A BLUE snowflake icon will appear inside the battery icon if the highest cell temperature is in a range where the battery thermal management system is working to keep the batteries cool.

3. **Battery Management System Battery Voltage Out of Range** - Indicator will illuminate if the Battery Management System battery voltage falls below 11.8 volts or rises above 14.5 volts.

CAUTION

If the Battery Management System Battery Voltage out of Range illuminates, remove the vehicle from service and repair before continued operation.

4. **Chassis Battery Voltage Out of Range** - Indicator will illuminate if the chassis battery voltage falls below 11.8 volts or rises above 14.5 volts.

CAUTION

If the Chassis Battery Voltage out of Range illuminates, remove the vehicle from service and repair before continued operation.

5. **Air Bag Fault** (If equipped) - Indicator will illuminate if a fault in air bag system is detected.

CAUTION

If the Air Bag Fault icon illuminates, personnel may not be protected by air bags in the event of a crash. Remove the apparatus from service until repaired.

6. **OK To Pump** - Indicator illuminates when the water pump is engaged, Park Brake is selected, and the drive motors are prepared to spin the pump.
7. **Pump Engage** - Indicator illuminates when the pump transfer case has mechanically shifted into pump mode.
8. **Automatic Traction Control** - Indicator illuminates when the Automatic Traction Control system senses wheel spin and engages to brake the wheel and provide traction to the opposite wheel.
9. **Anti-lock Brake System** - Indicator will illuminate if the Anti-Lock Brake System engages to modulate the brakes. This indicator will remain illuminated if the Anti-Lock Brake System Electronic Control Unit senses a fault.
10. **Speedometer Gauge** - Displays vehicle speed in miles per hour or kilometers per hour.
11. **PARK** - Indicator illuminates when the park brake is engaged.
12. **Speedometer Digital Indication** - Displays vehicle speed in miles per hour or kilometers per hour.
13. **Charge or Discharge Gauge** - GREEN bars downward indicate that the High Voltage batteries are being charged by brake regeneration, range extender operation, or external charging.
    BROWN bars upward indicate that power is being drawn from the High Voltage battery system and used by the vehicle.

14. **Electric Vehicle STOP** - Indicator will illuminate if the High Voltage control system Electronic Control Unit or High Voltage Battery Management System detects a CRITICAL fault.
    The Electric Vehicle STOP light will reset when the POWER button is cycled as long as the cause of the fault has been corrected.

CAUTION

If the Electric Vehicle STOP illuminates, remove the apparatus from service and repair before continuing operation.

15. **Electric Vehicle CHECK** - Indicator will illuminate if the High Voltage control system Electronic Control Unit or High Voltage Battery Management System detects a fault.
    The Electric Vehicle CHECK light will reset when the POWER button is cycled as long as the cause of the fault has been corrected.
16. **Range Extender STOP ENGINE Indicator** - Indicator will illuminate if the range extender engine Electronic Control Unit senses a critical fault.

CAUTION

Operating the Range Extender Engine with the STOP ENGINE indicator illuminated can cause serious engine damage. Shut down the Range Extender Engine using the Range Extender Engine Inhibit button from the Range Extender Engine display screen and operate the vehicle on Electric Vehicle power only until the critical fault can be repaired.

17. **Range Extender CHECK ENGINE Indicator** - Indicator will illuminate YELLOW if the range extender engine Electronic Control Unit senses a noncritical fault.

CAUTION

The CHECK ENGINE indicator illuminated means the engine is not operating within ideal conditions. Have the fault diagnosed and corrected at the next opportunity.

18. **Range Extender MIL Lamp** - Indicator will illuminate YELLOW if the range extender engine Electronic Control Unit detects an emissions related fault.

CAUTION

Operating the Range Extender Engine with a Malfunction Indicator Light (or Lamp) illuminated means the engine may be exceeding emissions limits. Have the fault diagnosed and corrected at the next opportunity.

19. **WAIT** - Indicator illuminates to warn the operator to WAIT before attempting to engage the engine starter to give the engine intake warmer time to heat up. Wait time will be longer in colder weather (up to 30 seconds in coldest temperatures). This function is performed by the system automatically when in Charge Mode Auto or Charge Mode Manual modes.
20. **Range Extender Air Filter** - Indicator will illuminate when the air filter requires replacement.
21. **REGEN** - When the REGEN indicator comes on this indicates that the Diesel Particulate Filter requires regeneration within the next 2-6 hours of operation. Regeneration can be accomplished by performing a "Parked" regeneration.
    When the REGEN light flashes perform the parked regeneration prior to operating the range extender engine again.

A “Parked” regeneration may be performed by pressing in the REGEN switch. SEE DIESEL PARTICULATE FILTER REGENERATION procedure.

22. **High Exhaust System Temperature** - The High Exhaust System Temperature lamp indicate that high exhaust temperatures may exist due to after-treatment regeneration.

⚠WARNING

When the High Exhaust System Temperature lamp is illuminated keep away from exhaust gas and do not park apparatus where the exhaust pipe points toward or near flammable material.

23. **Fuel Level** - This gauge displays the amount of diesel fuel remaining in fuel tank. The fuel tank indicator will illuminate YELLOW if fuel tank level falls below 1/8 tank.
24. **Diesel Emissions Fluid Level** - This gauge displays Diesel Exhaust Fluid level remaining in the Diesel Exhaust Fluid tank.

NOTICE

The gauge will only indicate the correct level when the Range Extender engine is running. When the engine is not running, Diesel Emissions Fluid level gauge will indicate the level of the Diesel Emissions Fluid from the last time the engine was running.

Diesel Emissions Fluid Level	
Indicators	**Condition**
Diesel Emissions Fluid Solid	**Diesel Emissions Fluid Level low**
Diesel Emissions Fluid Flashing	**Diesel Emissions Fluid Level below critical level**
Diesel Emissions Fluid Flashing + Check Engine	**Diesel Emissions Fluid Level critically low**
Diesel Emissions Fluid Flashing + Check Engine + Stop Engine	**Engine has been shut down or has idled for 20 hours after the Diesel Emissions Fluid tank has been run dry.**

NOTICE

Indicator will reset once Diesel Emissions Fluid tank is refilled.

25. **Range Extender Generator Output** - This gauge displays the power in kilowatts being generated by the range extender.
26. **Range Extender Coolant Temperature Gauge and Indicator** - This gauge displays the engine coolant temperature.
    Normal range. 180 degrees F (82 degrees C) - 210 degrees F (98.88 degrees C).
    The indicator will illuminate RED if engine temperature rises above 225 degrees F (107.22 degrees C).

CAUTION

High temperature indicates that the vehicle is being operated in a temperature above its design capability, or that there is a fault in the cooling system. If the Range Extender Engine Coolant High Temperature Indicator is illuminated, shut down the Range Extender Engine using the Range Extender Engine Inhibit button from the Range Extender Engine display screen and operate the vehicle on Electric Vehicle power only until the fault can be repaired.

27. **Range Extender Engine Oil Pressure Gauge and Indicator** - This gauge displays the engine oil pressure. Oil pressure will fluctuate depending on operating conditions. Normal oil pressure range is between 10 psi. (68.94 kPa)and 75 psi. (517.10 kPa).

CAUTION

When the Range Extender Engine is first started the gauge should read oil pressure within approximately 15 seconds. If after this time no oil pressure is displayed shut down the Range Extender Engine using the Range Extender Engine Inhibit button from the Range Extender Engine display screen and operate the vehicle on Electric Vehicle power only until the fault can be repaired.

Indicator will illuminate RED if engine oil pressure drops below 5 psi. (34.47 kPa). If the Range Extender Engine Low Oil Pressure Indicator is illuminated, shut down the Range Extender Engine using the Range Extender Engine Inhibit button from the Range Extender Engine display screen and operate the vehicle on Electric Vehicle power only until the fault can be repaired.

28. **Range Extender Active** - Indicator will illuminate GREEN when the range extender engine is operating.
29. **Derate Indicator** - The Derate icon indicates that the Electric Vehicle traction motors are in a derated condition. If this occurs, expect less acceleration and less speed on hills and less pumping capability. The icon will disappear when the derate condition has is no longer in effect.
30. **High Beam Indicator** - Indicator will illuminate when the high beam switch is engaged.
31. **Right Hand Turn Signal Indicator** - Indicator flashes whenever turn signal switch lever is moved upward.
32. **Drive Selection** - Displays vehicle Drive Mode selection.
33. **Odometer** - Displays the distance driven.
34. **Left Hand Turn Signal Indicator** - Indicator flashes whenever turn signal switch lever is moved downward.
35. **High Voltage Battery State of Charge (SOC)** - This bar displays the usable state of charge of the high voltage batteries.

High Voltage Battery State of Charge	
Color	**Condition**
Green	**Usable State of Charge is above 50%**
Yellow	**Usable State of Charge is between 15% and 50%**
Red	**Usable State of Charge is below 15%**

NOTICE

State of Charge is a measure of the High Voltage battery voltage, which cannot be measured when the batteries are under a load. During Electric Vehicle operation the State of Charge is approximated by summing the current flowing into and out of the High Voltage batteries. The State of Charge resets whenever the POWER is cycled allowing the voltage to be checked before a load is applied. Expect the State of Charge to change after POWER is cycled.

36. **High or Low Range (Option)** –

    Rabbit indicates the Electric Vehicle is in high range for normal operation.

    Turtle indicates that the Electric Vehicle is in low range for steep hill climbing.

NOTICE

Bring vehicle to a stop before shifting between ranges.

37. **DRIVE Indicator** - Indicator appears when the vehicle is in a state to drive.

38. **Doors Open** - Cab or body doors not closed or features not stowed.

CAUTION

Refer to the AJAR TEXT or AJAR DISPLAY on the DRIVER DISPLAY to determine which doors are open or which features are not stowed.

39. **Seat Belts Not Buckled** - Seat belts not buckled.

NOTICE

The alert will not be satisfied if the belt is buckled before a person is sitting in the seat.

40. **Primary Low Air Indicator** - Indicator will illuminate RED if the primary air pressure (pressure in the reservoir supplying the REAR brakes) falls below 60 psi. (413.68 kPa).
41. **Secondary Low Air Indicator** - Indicator will illuminate RED if the secondary air pressure (pressure in the reservoir supplying the FRONT brakes) falls below 60 psi. (413.68 kPa).
42. **Primary Air Pressure** - Displays air pressure of the REAR brake system air tank reservoir(s).
43. **Secondary Air Pressure** - Displays air pressure of FRONT brake system air tank reservoir(s).
44. **Electric Vehicle Battery Alert** - Indicator will illuminate with certain faults in the High Voltage batteries. One fault may be that the contactors in one of the battery packs has failed to close. If this occurs, expect less acceleration and less speed on hills. Place vehicle on charger to rebalance. The Electric Vehicle Battery Alert icon will reset when the POWER button is cycled as long as the cause of the fault has been corrected.

NOTICE

If the Electric Vehicle Battery Alert illuminates have the fault diagnosed and corrected at the next opportunity.

45. **Battery Thermal Event Alert** - Displays if there are signs that an Electric Vehicle Battery Thermal Event is imminent.

⚠ DANGER

Park immediately in a safe location away from vehicles, structures, and combustibles. Turn OFF Power and Run switches. Exit vehicle and remove the First Responder Loop. Prepare for potential battery fire.

46. **Motor Temperature** - Displays the drive motor temperature in degree F or degree C. Ribbon will illuminate RED if the drive motor temperature exceeds 203 degrees F (95 degrees C).

CAUTION

If the Motor Temperature indicator illuminate RED, remove the vehicle from service and repair before continued operation.

VISTA CONTROL DISPLAY

Home Menu

Home Menu

1. **Drive Mode** - Select acceleration algorithm to support normal, economy, or sport driving.
2. **Optional Feature** - Customized depending on department specifications.
3. **Optional Feature** - Customized depending on department specifications.
4. **Optional Feature** - Customized depending on department specifications.
5. **Backup Camera** - Select to bring up back-up camera when not in reverse.
6. **Optional Feature** - Customized depending on department specifications.
7. **Ajar Text** - Select to switch to a screen that displays the name of any feature that is not stowed or closed.
8. **Ajar Display** - Select to switch to a screen that displays a graphical representation showing any feature that is not stowed or closed.

Warning Light Menu

Warning Light Menu

1. **Optional Feature** - Customized depending on department specifications.
2. **Optional Feature** - Customized depending on department specifications.
3. **Upper Warning** - Upper Warning Lights ON or OFF.
4. **Lower Warning** - Lower Warning Lights ON or OFF.
5. **Load Manager Override** - Jump to screen to adjust load manager settings.
6. **Optional Feature** - Customized depending on department specifications.
7. **Optional Feature** - Customized depending on department specifications.
8. **Optional Feature** - Customized depending on department specifications.

System Info

System Information

1. **Charge Limit** - Select the State of Charge value at which the fast charger will stop charging.
2. **Battery Thermal Management System Mode** - Selects the battery heating and cooling mode as SUMMER, WINTER, or NORMAL based on the climate and the season.
3. **Warn Event Acknowledge** - Allows the operator to silence the seat belt or ajar audible alert. The alert will reset when the POWER is cycled.
4. **V-MUX Voltage Info** - Details on voltage readings for each system node. Used by technicians to troubleshoot network faults.
5. **Voice Alert** - Allows the operator to toggle the voice alert ON or OFF, and to select the voice gender. When OFF, only the normal driving alerts will be silenced, important warning messages will still be audible.

6. **Cab Heater Coolant Purge** - Allows a technician to run the cab heater coolant pump to aid in purging air during the bleeding process.

NOTICE

This feature will only be available on apparatus equipped with the Warm Climate cab heat option).

7. **Display Mode** - Select between various display brightness settings.
8. **V-Mux System Info** - Set-up and troubleshooting information.

Auxiliary 1

Auxiliary 1

1-8. **Lighting Controls** - Lighting controls customized depending on department specifications.

Heat A/C

Heat A/C

1. **Climate Mode** - Toggle through to select Heat, A/C, Defog, Defrost, or AUTO.
2. **Temperature Up** - Increases the temperature set point.
3. **Temperature Down** - Decreases the temperature set point.
4. **Optional Feature** - Customized depending on department specifications.
5. **Front Fans Increase** - Increases the speed of the blower fans on the front system.

6. **Front Fans Decrease** - Decreases the speed of the blower fans on the front system.
7. **Rear Fans Increase** - Increases the speed of the blower fans on the rear system.
8. **Rear Fans Decrease** - Decreases the speed of the blower fans on the rear system.
9. **Heater ON/OFF Indicator (Option)** - On apparatus equipped with the diesel fired cab heater option this telltale indicates when the unit is ON and producing heat.

Range Extender Engine Menu

REx Menu

1. **Charge Mode** - Use this button to toggle through four selectable Range Extender Engine Charge Modes; Auto, Manual, Inhibit, or Service.

- **Charge Mode Auto - Toggle to Charge Mode** Auto to allow the Range Extender Engine to recharge the Electric Vehicle batteries automatically as needed. POWER and RUN switches must be ON. This Icon is illuminated BLUE as default whenever the POWER switch is cycled. In this mode the Range
- Extender Engine will start automatically when the State of Charge drops below 15% any time the
- POWER and RUN switches are ON. Once started the Range Extender Engine remains ON until the State of Charge reaches 50% or the Range Extender Engine STOP is pressed, the POWER switch is cycled, or the RUN switch is OFF.
- **Charge Mode Manual - Toggle to Charge Mode Manual** if the State of Charge is below 85% and you wish to have the Range Extender Engine start and charge the Electric Vehicle Batteries. POWER and RUN switches must be ON. The Range Extender Engine will run and charge the batteries until the State of Charge reaches 90%, or the charge mode is changed. The Range Extender Engine will begin charging again when the State of Charge drops back below 85%. The Mode will reset to Charge Mode Auto when the POWER switch is cycled.
- **Charge Mode Inhibit** - Toggle to Charge Mode Inhibit to suppress operation of the Range Extender Engine. The Range Extender Engine will not START until one of the other modes is selected. In Charge Mode Inhibit the Range Extender Engine will not turn on and charge the batteries, even if the Electric Vehicle Battery State of Charge drops below 15%. This mode resets to Charge Mode Auto when POWER switch is cycled. Turns RED when selected.

NOTICE

When the usable State of Charge drops below 0% (as shown on the displays) there will not be sufficient power to drive or pump. The Electric Vehicle systems will stay live and 12 Volt power will be available until the actual State of Charge drops to 0% (this actual State of Charge is not visible to the operator). Once the actual State of Charge drops to 0% everything shuts down.

- **Charge Mode Service** - Toggle to Charge Mode Service to operate the Range Extender Engine without charging for service or diagnostics. Can only be selected if.
    - Battery Power is in POWER.
    - Parking Brake is Engaged.
    - ROAD Mode is selected.
    - Button turns BLUE when active. Select the Range Extender Engine Maintenance screen to control engine speed.

2. **Maintenance Screen** - The maintenance screen allows manual speed control of the engine along with an expanded list of engine data.
3. **Optional Feature** - Customized depending on department specifications.
4. **Optional Feature** - Customized depending on department specifications.
5. **Regen Request** - Sends request to the Range Extender Engine Electronic Control Unit to command regeneration of the exhaust emissions system (will only function when the engine emissions system is ready for regeneration)
6. **Regen Inhibit** - Select if the vehicle is in a situation where an engine regeneration would be unsafe or impractical.

NOTICE

The Range Extender Engine will not start automatically to perform a regeneration. Automatic regeneration will only occur if the engine is already running.

7. **Optional Feature** - Customized depending on department specifications.
8. **Range Extender Engine Emergency Stop** - Range Extender Engine Emergency Stop allows the operator to STOP the engine immediately without a cool down period. Use only if the safety requires the engine to be stopped as quickly as possible.

Range Extender Engine Maintenance

Range Extender Engine Maintenance

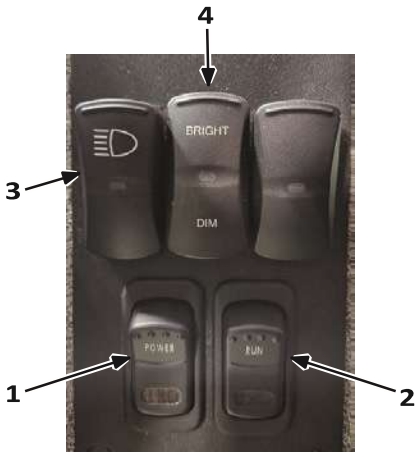
1. **Range Extender Engine START** - Press Range Extender Engine Manual Start to engage the starter motor and crank the engine if.

    - Parking Brake is Engaged (DRIVE MODE in N).
    - Service Mode is selected.
    - Button will be grayed out until the Service Mode is activated.

2. **Range Extender Engine STOP** - Press Range Extender Engine STOP to shut down the Range Extender Engine. Range Extender Engine will not start again until one of the other Range Extender Engine modes is selected or the Battery Power switch is cycled off and on. Button will be grayed out until the Service Mode is activated.
3. **Optional Feature** - Customized depending on department specifications.
4. **Charge Mode** - Use this button to toggle through four selectable Range Extender Engine Charge Modes; Auto, Manual, Inhibit, or Service.
5. **RPM Control Enable** - Press RPM Control Enable if it is necessary to control the Range Extender Engine speed without charging.
6. **RPM UP** - Increase the Range Extender engine speed. Only functional in the Service Mode. Button will be grayed out until the Service Mode is activated.
7. **RPM Down** - Decrease the Range Extender engine speed. Only functional in the Service Mode. Button will be grayed out until the Service Mode is activated.
8. **Range Extender Engine Emergency Stop** - Range Extender Engine Emergency Stop allows the operator to STOP the engine immediately without a cool down period. Use only if the safety requires the engine to be stopped as quickly as possible.

OTHER CONTROLS IN THE CAB

Dash Controls



Dash Controls

1. **POWER** - Used to energize vehicle electrical system.
   When ON the following systems will be live.

   - **Battery Management System** – Electric Vehicle Battery Management System.
   - **Battery Thermal Management System** – Electric Vehicle Battery Thermal Management System.
   - **Electric Vehicle Instrument Cluster** – Driver Dash Display.
   - **e-Pump** – Pump Operator Display.
   - **VISTA** – V-MUX Display and Controls.
   - **HVAC** – Cab Heating, Ventilation, and Air Conditioning.
   - **12 Volt Electrical** – Communications, Power ports, Warning lights, Scene Lights, etc.

2. **RUN** - Brings the Electric Vehicle Drive system on-line. Requires the POWER switch to be engaged.
   When ON the following systems will be live.

   - Electric Vehicle Traction Motor (Drive, Reverse, Pump).
   - Range Extender Engine Electric Vehicle power generation.

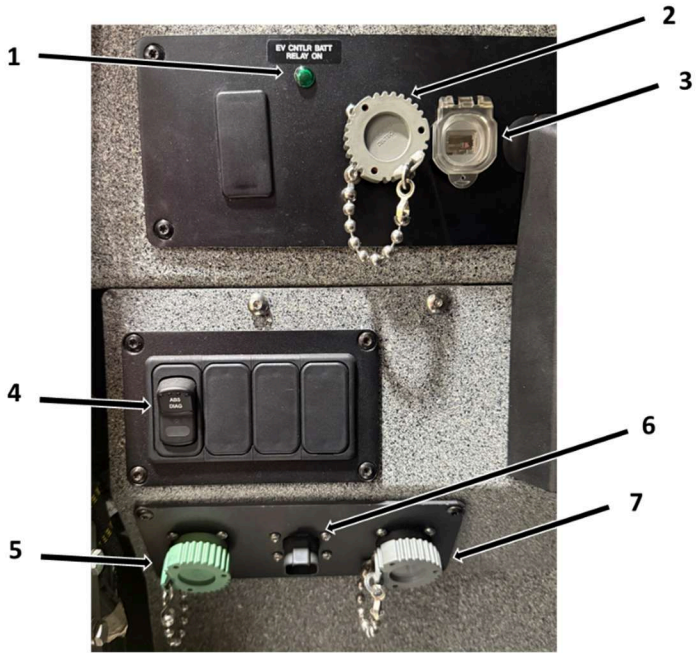
3. **Headlights** - Used to illuminate vehicle driving light system.

   Top - Headlights ON.
   Center - Running lights ON.
   Bottom - OFF.

4. **Panel Dimmer** - Used to vary the lighting intensity of the shift selector.

   Top - Increase lighting intensity.
   Bottom - Decrease lighting intensity.

12V Battery Saver Relay



Electric Vehicle Wake/Electric Vehicle Sleep

1. **EV Battery Saver Relay Monitor** -This GREEN indicator will glow steadily when the BATTERY SAVER RELAY is in the AUTO REM mode. This means that the battery guard system is ready to protect the 12 Volt EV battery and 12V chassis batteries. If the voltage in the EV 12V battery drops below 12 Volts, the power relays will OPEN and the batteries will disconnect from the main 12V system, protecting them from discharging further.

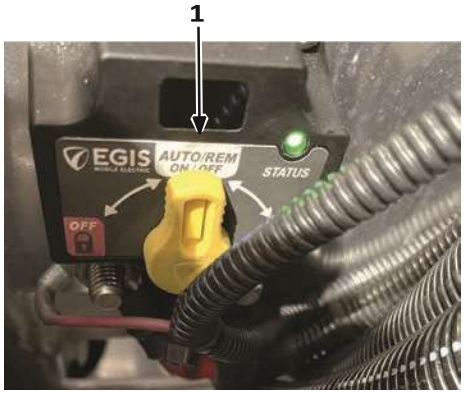
    - If the battery saver relay is placed in either the ON or OFF position, the GREEN monitor lamp will flash.

CAUTION

Do not attempt to charge the vehicle with the battery relay in the OFF position. Do not turn the battery relay to the OFF position with the Charge Plug connected. Either action will cause the Charge Plug to be locked into the Charge Port and you will need to manually disengage the Charge Plug Lock to release it (see troubleshooting section).

2. **Occupant Protection Diagnostic Port** - Port for interrogating the airbag systems.
3. **Electric Vehicle Instrument Cluster Software Update Port** - Port that will accept an Ethernet CAT 6 socket used for updating software for the Electric Vehicle Instrument Cluster.
4. **Anti-Lock Brake System Diagnostics Switch** - Switch to initiate Anti-Lock Brake System diagnostics.
5. **On-Board Diagnostics Port** - On-Board Diagnostics port. On the Vector this will only provide AntiLock Brake System information since the Range Extender Engine is not an on-road emissions engine and therefore does not feature On-Board Diagnostics.
6. **V-MUX Diagnostic Port** - Port to interrogate the vehicle multiplex electronics system.
7. **Engine Diagnostic Port** - Port to interrogate the Cummins range extender diesel engine. You must have the engine in service Mode for the diagnostics to function.

12 Volt Battery Saver Replay



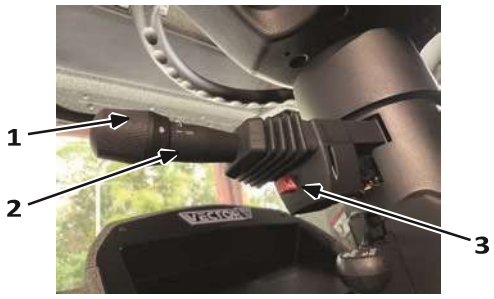
12 Volt Battery Saver Relay

12 Volt Battery Saver Relay - This relay is located behind the right side pump module access panel.

Auto/REM. The center position provides power to the Electric Vehicle controllers until the system voltage drops below 12 volts at which time it will shut off power to retain the battery voltage and allow the vehicle to be woken up without recharging.

- **OFF**. Placing the switch in the OFF position shuts off power to the Electric Vehicle controllers manually.
- **ON**. Placing the switch in the ON position keeps the Electric Vehicle controllers powered ON constantly.

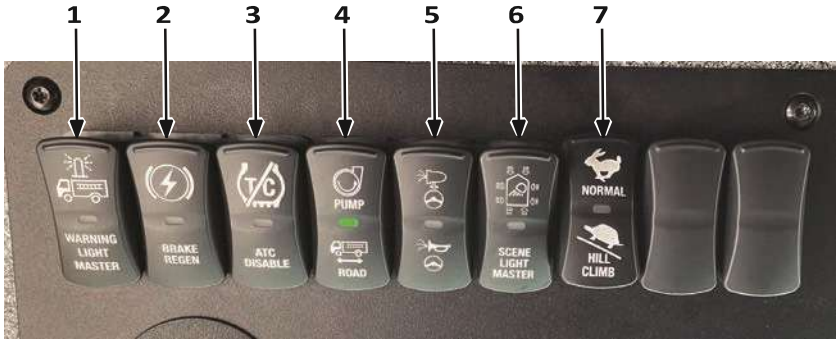
Steering Column Stalk



Steering Column Stalk

1. **Wiper/Washer/Intermittent Switch** - Rotate switch to active and control windshield wipers. Press switch inward to activate windshield washer.
2. **Turn Signal Stalk** - Move stalk forward or backward to activate turn signal lights. Pull stalk upward to switch from low beam headlights to high beam headlights.
3. **Hazard Flashers** - The hazard flasher switch is located underneath the turn signal stalk and is not visible when sitting in the driver seat, but can be seen when standing on the ground prior to entering the cab. When sitting in the driver seat reach your left hand under the stalk and feel for the slider switch. Pull red switch OUT to set hazard lights.

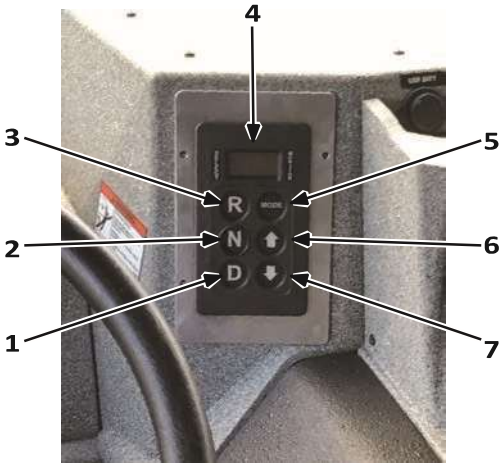
Overhead Controls



Overhead Controls

1. **Warning Light Master** - Press the Warning Light Master to Illuminate the warning lights in the "Calling for Right of Way" mode (if the Park Brake is applied) or "Blocking Right of Way" (if the Park Brake is released).
2. **Brake Regen** - Press BRAKE REGEN to turn ON or OFF the brake regeneration feature. With BRAKE REGEN ON the vehicle will be slowed down by the traction motors when the accelerator pedal is released. During brake regeneration the traction motors convert vehicle momentum into electrical energy and the batteries are recharged.
3. **Automatic Traction Control Disable** - Automatic Traction Control feature is disabled.
4. **Road or Pump Mode** - Pressing ROAD shifts the transfer case and directs traction motor power to the rear wheels. Use the shift selector and accelerator pedal to control motion of the vehicle.
   Pressing PUMP shifts the transfer case and directs traction motor power to the water pump. Use the pump controller display at the pump panel to control the action of the pump.
5. **Steering Wheel Horn Function** - Selects which audible warning device that will be activated when the steering wheel center is pressed.
6. **Scene Light Master** - Activates all the scene lights.
7. **Hill Climb Mode (Option)** - Vector may be equipped with a two-speed rear axle. In normal operation the axle should be left in the NORMAL mode. Shift to HILL CLIMB mode for creeping up steep inclines at slower speed.

Drive Mode Selector



Drive Mode Selector

1. **Drive** - Pressing **D** activates the forward driving mode. Pressing the accelerator pedal will cause forward motion.

⚠WARNING

Do not use the accelerator to hold the vehicle on a hill. Doing so will unnecessarily waste battery power and will cause the motor invertors to heat up, eventually causing them to over-heat. Overheated invertors will protect themselves by ceasing to function and the traction motors will lose power until the invertors cool down again. If power is lost, hold the vehicle with the Service Brake and Park Brake.

2. **Neutral** - Pressing **N** places the vehicle in Neutral.

⚠WARNING

While in Neutral the vehicle will be free to move. The drive motors will rotate with the driveshaft, but they will not prevent the vehicle from moving. Only the Park Brake and manually placed wheel chocks will keep the vehicle from rolling.

3. **Reverse** - Pressing **R** activates the reverse driving mode. Pressing the accelerator pedal will cause forward motion. Speed in Reverse is limited to 9 mph (14.48 km).
4. **Drive Mode Display** - Displays the selected drive mode.
   A dash symbol - - indicates that the drive mode is disabled due to.

   - Vehicle is plugged into the charger.
   - Apparatus is pumping water.
   - RUN switch in OFF position.

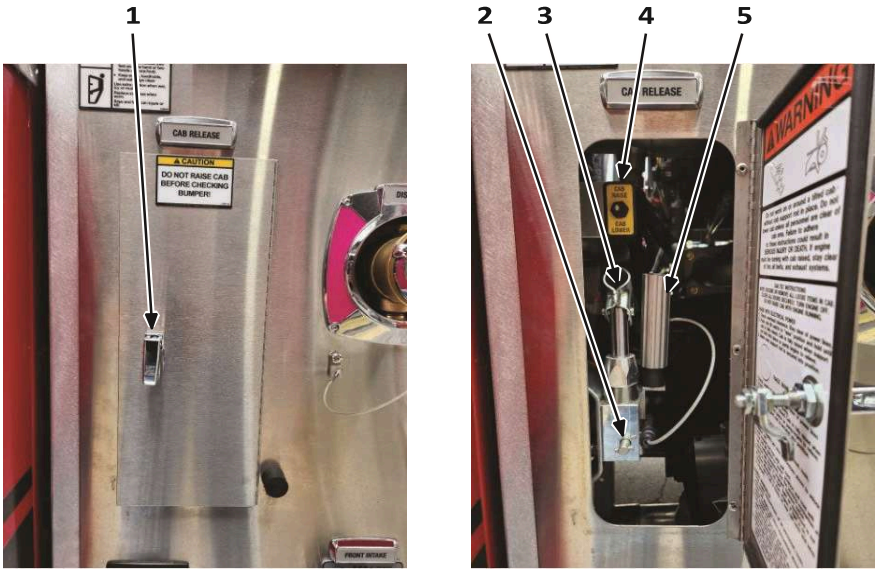
5. **Mode Selector** - Inactive.
6. **Up Arrow** - Inactive.
7. **Down Arrow** - Inactive.

Brakes

Brakes

1. **Park Brake** - Pull to apply the Parking Brake. Push to release the Parking Brake.
   The DRIVE Mode will automatically be set to N any time the parking brake is applied and it will stay in N until Drive Mode (D) or Reverse Mode (R) is selected.
2. **Service Brake** - Press to activate the service brakes and slow the vehicle.

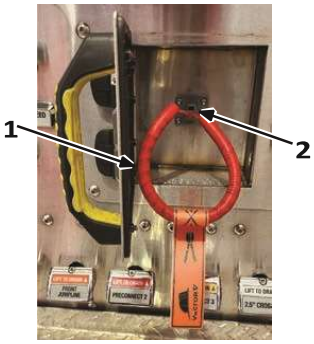
Cab Tilt Controls



Cab Tilt Controls

1. **Cab Tilt Access Door** - Typical access door shown.
2. **Manual Pump Valve** - Controls the flow of oil from the manual lift pump.
3. **Manual Pump** - Manual pump to supply cab lift pressure if electrical power is not available.
4. **Cab Tilt Control** - Controls the flow of oil to or from the hydraulic cab lift cylinders.
5. **Safety Latch Release** - Pull this cord to release the safety latch.

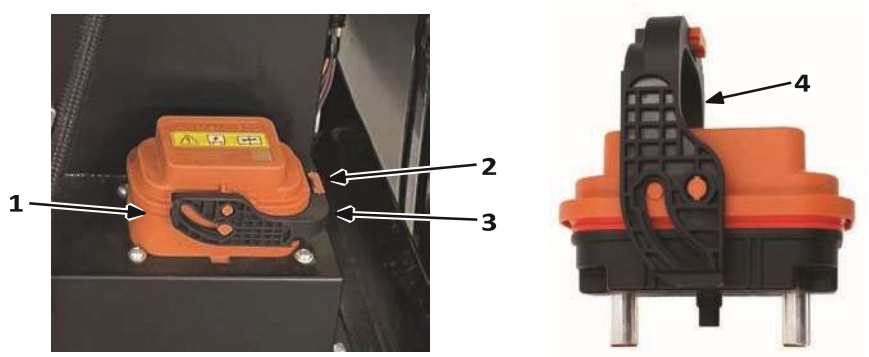
First Responder Cut Loop (Service Loop)



First Responder Cut Loop (Service Loop)

1. **First Responder Cut Loop** - Low Voltage loop that when cut will isolate the high voltage inside the High Voltage battery packs. When this wire loop is cut none of the orange High Voltage cables will be energized. This loop is also referred to as the Service Loop because it is often removed as one of the steps in making the vehicle safe for service functions.
2. **First Responder Cut Loop Plug** - For service purposes the First Responder Cut Loop Plug can be removed without need to cut the wire loop.

Manual Service Disconnect



Manual Service Disconnect

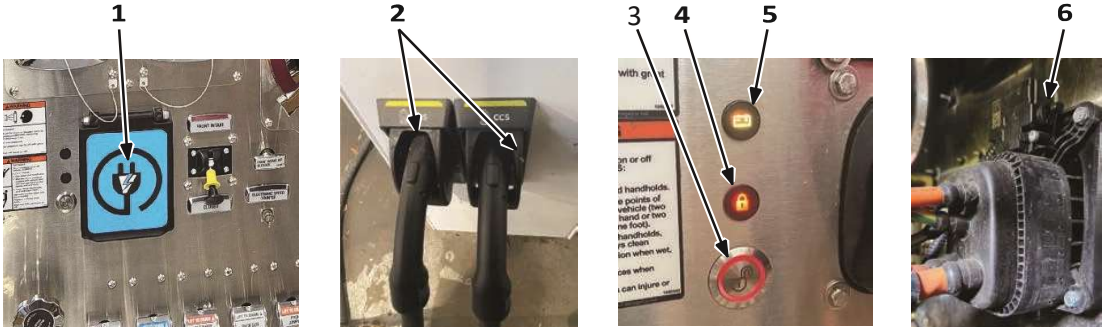
1. **Manual Service Disconnect** - Removal of the Manual Service Disconnect opens the high voltage circuit within the battery pack and retains all the energy inside the pack. Once the Manual Service Disconnect on each battery pack is removed, none of the High Voltage cables or devices on the vehicle will be energized.
2. **Manual Service Disconnect Locking Tab** - Pull up on this locking tab before attempting to pull up on the Locking Lever.

CAUTION

The locking tab is delicate and will break if the lever is force up without first pulling up on the tab.

3. **Manual Service Disconnect Locking Lever** - Pull this lever to lock or unlock the Manual Service Disconnect in its socket.
4. **Manual Service Disconnect Locking Lever** - Locking lever shown in the unlocked position.

Charging Features



Charging Features

1. **Charge Port** - Receptacle for charging.
2. **Charge Plug** - Plug from the charging station.
3. **Charge Plug Unlock Button** - Press to quit charging and unlock Charge Plug from Charge Port.
4. **Charge Plug Lock Indicator** –

- **RED**. Charge plug is locked in place.
- **GREEN**. Charge plug is unlocked and ready to remove.

5. **Charge Indicator**

   - **Steady Yellow**. Charging.
   - **Flashing Yellow**. Charging above 95% State of Charge.

6. **Charge Plug Lock Manual Release** - Located on the back side of the Charge Port. Use to unlock the Charge Plug if it gets stuck.

VEHICLE OPERATIONS

OVERVIEW

The procedures contained in this section of the Operator's Manual explain how to safely and properly operate your apparatus. Any deviation from these procedures increases the risk of an accident occurring. Accidents may result in damage to the apparatus, as well as injury or death to firefighters and other people.

CHARGING THE ELECTRIC VEHICLE BATTERIES

Charging Station Compatibility

The Vector Electric Vehicle batteries must be charged with a CSS capable DC Fast charging station. The recommended charge rate, as well as the maximum charge rate, is 120 Kilowatts.

Example DC Fast Charge Stations

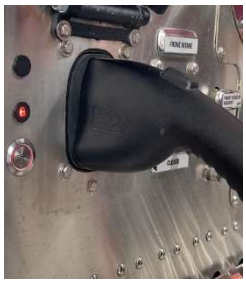
Vector should charge on any CSS DC Fast Charge Station as long as it is equipped with the correct CSS connector plug. Public charging stations require the user to enter a credit card or connect via a phone app.

Connecting to the Charger

- Remove the CSS charge plug from the station and follow the instructions on the Charge Station display.
- Insert the Charge Plug into the Vector Charge Port socket.
- The Charge Plug Lock Indicator will light up GREEN momentarily, and then turn RED to show that the plug is locked into the socket.
- The charging station will now begin establishing communicating with the Vector and will read critical system values such as battery cell temperature, state of charge, isolation resistance, etc. Once a successful link has been established the charge process can begin.
- The operator may need to press some control on the charging station to begin current flow, or charging may begin automatically.
- Once charge is flowing the Charge Indicator will light BLUE. When the State of Charge exceeds 95% the Charge Indicator will flash BLUE.
- When charge is flowing it will also be indicted by GREEN bars on the Cab Dash Display and the Pump Control Display.

NOTICE

The process of establishing communication between the charger and the truck is a complex process. Different chargers take different amounts of time to connect, but expect the process to take up to 60 seconds between the time the plug is connected and the time the charging has begun. If the charger fails to connect, unplug the charger, cycle power on the vehicle, and plug in again



Disconnecting the Charger

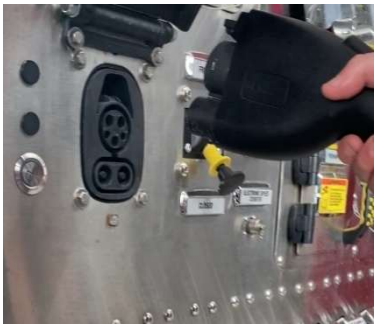
Disconnecting the Charger

- With the Charge Plug inserted properly the Charge Plug Unlock Button will be RED.
- Press and Hold the Charge Plug Unlock Button.
- Wait for the Charge Plug Lock Indicator to turn GREEN. The Charge Plug is now unlocked.
- Press the trigger on the Charge Plug and remove it.
- Place the Charge Plug back in the station receptacle.

NOTICE

One short press of the Charge Plug Unlock Button will turn OFF the charger but will not unlock the plug. A second short press will unlock the plug and turn the light GREEN. Holding the Charge Plug Unlock Button for about 8 seconds will both stop the charge and unlock the plug.





Charging

NOTICE

Tesla charging stations are not compatible with Vector.

NOTICE

Vector has very high Electric Vehicle storage capacity and some public charge stations may time-out before a full State of Charge is reached. Monitor the charge process and re-start the charge process if this occurs.

When a charge plug is inserted into the socket the Electric Vehicle system will be active even if the POWER and/or RUN switches or OFF and even if the charger is not providing power. This allows devices such as the air compressor and Battery Thermal Management System to operate during the charge process.

PRE-TRIP INSPECTION

Driving a heavy duty truck for hire requires a commercial driver's license and the performance of a pre-trip inspection prior to driving. A Sample Driver's Daily Inspection Form is available in the service section of this manual. Your state law and your department's Standard Operating Procedure may allow you to drive without a commercial driver's license, but this does not negate the importance of ensuring that your vehicle is safe to operate on public roads. Perform a pre-trip inspection prior to driving, or ensure that one has been performed recently according to your department's safety procedures. Add the following Electric Vehicle unique inspections to the pre-trip inspection of a Vector apparatus.

Range Extender Engine Start and Run Check

The Range Extender diesel engine should be run periodically to ensure that it is in working condition, and that the fuel and Diesel Emissions Fluid tanks are full.

- ☐ Place the Power switch in the ON position.
- ☐ Ensure that the Park Brake is engaged.
- ☐ Ensure that the Road or Pump Mode switch is in the Road mode.
- ☐ Toggle to the Charge Mode Service screen on the Driver Control Display.
- ☐ Select the Maintenance Screen.
- ☐ Press the Range Extender Engine Start button.
- ☐ Let the engine idle for 2 minutes or longer.
- ☐ Press the Range Extender Engine Stop button.

NOTICE

The Range Extender Fuel Level gauge will indicate the amount of fuel in the tank whenever the Power switch in ON. The Range Extender Diesel Emissions Fluid Level gauge will not indicate an accurate reading unless the Range Extender Engine is running.

BEFORE DRIVING

Before driving or riding in your vehicle, you must ensure that you understand how to do so safely.
Read the safety section of this manual and make sure you are prepared to follow all safety procedures.

Wheel Chocks

- ☐ Your vehicle should be secured using Wheel Chocks.
- ☐ If parked on level ground chock on both sides of one of the rear wheels.
- ☐ If parked on a grade, chock on the down-hill side of one rear wheel on each side of the vehicle.
- ☐ Remove wheel chocks and secure them on the vehicle.

Disconnect the Charging Plug

- ☐ If the plug is connected to the vehicle, press the Charge Plug Unlock Button.
- ☐ Observe the Charge Plug Lock Indicator.
- ☐ Once the Charge Plug Lock Indicator turns GREEN remove the Charge Plug and secure it safely away from the vehicle.

Disconnect the Shoreline Air Inlet (If equipped)

- ☐ Disconnect the air hose from the Shoreline Air Inlet.
- ☐ Secure the air hose safely away from the vehicle.

NOTICE

Any time the Power switch is ON the system is monitoring the air brake pressures. If the pressure in either of the air brake systems drops below the preset value, the compressor will come on and charge the system. In normal operating conditions therefore a shoreline air inlet is not required.

Enter the Cab

Enter and exit the cab using three points of contact as described in the Safety Section of this manual.

Secure Equipment.

- ☐ Secure all equipment or loose objects in approved compartments or mounting brackets or remove them from the occupant area.

Power Up the Systems

- ☐ Place the POWER Switch in the ON position.
- ☐ Wait for the dash gauges to wake up and complete the prove-out sequence.
- ☐ Check for indicator lamps or warning messages and take action if necessary.
- ☐ Place the RUN Switch in the ON position.

Driving Area Adjustment

- ☐ Adjust the driver seat so you can reach the foot controls including the Accelerator Pedal and Brake Treadle. The heal of your right foot should be resting securely on the floor of the cab while driving.
- ☐ Adjust the Steering Wheel for reach and comfort.
- ☐ Adjust the right and left Side View Mirrors.
- ☐ Buckle your seat belt.
- ☐ Adjust the seat belt for comfort if equipped with height adjustment.

Observe Dash Gauges

- ☐ Check the Air Brake Pressure gauges and make sure they indicate at least 60 psi. (413.68 kPa). Pressure should continue to build as the compressor runs. If the air pressure does not increase take the truck out of service until the system is repaired.
- ☐ Range Extender Engine Fuel Tank and Diesel Emissions Fluid Tank should be full. This will ensure that you will have back-up power if your response requires extended performance.
- ☐ Voltage Gauge in the normal range

NOTICE

The Diesel Emissions Fluid gauge will indicate the correct level only if the Range Extender Engine is running.

Climate Control

- ☐ Adjust the Heat, Defrost, and Air Conditioning system to ensure comfort and visibility.
- ☐ Select the climate mode by toggling through the modes on the Climate Control display screen.

Prepare to Drive

- ☐ Observe occupants to ensure that they are properly seated and belted.
- ☐ Observe the Do Not Move Apparatus warning indicator. If this lamp is illuminated, determine the cause and take action prior to driving.
- ☐ Lock all cab doors.

ROAD OPERATION

Driving the Vehicle

- ☐ Depress Brake Treadle firmly.
- ☐ Release the Park Brake.
- ☐ If backing up, use a spotter and follow procedures found in the Safety Section of this manual.
- ☐ Shift to the desired drive mode (D, or R) using the Drive Mode Selector.
- ☐ Observe Side View Mirrors.
- ☐ Observe Backup Camera.
- ☐ Drive safely and in accordance with applicable laws, department Standard Operating Procedures, and the instructions found in the Safety Section of this manual.

NOTICE

The service brake treadle must be depressed firmly before the Drive Mode Selector will shift from neutral (N) to drive (D) or from neutral (N) to reverse (R).

Shift on the Fly

- Vector can be placed in neutral (N) while in motion from either drive (D) or reverse (R).
- While moving forward Vector can be shifted from neutral (N) to drive (D), but not to reverse (R).
- While moving backward Vector can be shifted from neutral (N) to reverse (R), but not to drive (D).
- At slow speeds (2 mph (3.21 km) or less) Vector will stay in neutral (N) until the vehicle is stopped.

Brake Regeneration

Brake Regeneration uses the traction motors to slow the vehicle. The motors convert to generators and push energy back into the Electric Vehicle batteries.

You can see this happening while driving by observing the Charge or Discharge Gauge. When the gauge is in the green, the batteries are receiving a charge.

It is best practice to leave the Brake Regeneration switch in the ON position at all times. If you are driving in slippery conditions you can chose to turn it OFF, but keep in mind that brake regeneration will be disabled automatically during an Anti-Lock Brake System event.

Engage the Brake Regen switch prior to driving. If you must turn Brake Regen ON or OFF with the vehicle in motion, do so with your foot off the accelerator pedal. If you switch Brake Regen ON or OFF while driving above approximately 10 mph (16.09 km) with the accelerator applied, be prepared to adjust accelerator pedal application because you will feel the shift in mode. The accelerator pedal torque request mapping is different depending on whether the Brake Regen switch is ON or OFF.

Brake regeneration will function down to approximately 2 mph (3.21 km) after which you will need to use the service brakes to bring the vehicle to a complete stop.

Parking the Vehicle

- Bring the vehicle to a complete stop.
- Engage the Park Brake (Drive Mode Selector will automatically shift to N).
- Place Wheel Chocks.
- If parked on level ground chock on both sides of one of the rear wheels.
- If parked on a grade, chock on the down-hill side of one rear wheel on each side of the vehicle.
- Secure the Vehicle.

Parking at a Response Scene

When parking at a Response Scene where security is not a concern leave the POWER and RUN switches ON. By leaving the POWER switch ON the Electric Vehicle batteries will continue to provide 12V power to operate all functions such as warning lights, scene lights, HVAC, etc. By leaving the RUN switch ON the truck will be ready to engage the range extender if the SOC drops below 15%.

Climbing Hills

The Vector drive motors operate differently from a diesel engine and transmission. The motors are very powerful, but they are happiest when not turning very slowly. Avoid creeping slowly up a hill (less than 5 mph (8.04 km)) if it can be avoided. If you do need to creep slowly the invertor's will heat up quickly and you will hear the cooling fans come on.

CAUTION

Continuous slow creeping under heavy load may overheat the invertors and cause the motors to lose torque.

Speed Bumps and Curbs

Do not expect to climb curbs, speed bumps, or driveway transitions if you start with the wheels right against the obstruction. The torque required to lift the axle vertically is very great. A light vehicle inertia can usually solve this. If you find that the vehicle is not climbing an obstruction, just back away slightly and then proceed with just a little "running start".

Anti-Lock Brake System

The Anti-Lock Brake System electronically monitors vehicle wheel speed at all times. It modulates the brake application at each wheel to minimize the risk of wheel lock-up and improve stopping distance especially on slippery surfaces. For best stopping distance performance, always apply steady pressure on the Brake Treadle. Do not "pump" the brakes. Anti-Lock Brake System does not require any operator intervention to function.

Electronic Stability Control

The Electronic Stability Control system uses Anti-Lock Brake System to help keep the vehicle pointed in the direction that the steering wheel is pointed. It does this by reading the angle of the steering wheel and the actual direction of travel of the vehicle. It will also reduce the torque from the traction motors to reduce instability during aggressive maneuvers. Anti-Lock Brake System does not require any operator intervention to function.

Automatic Traction Control

Automatic Traction Control uses the Anti-Lock Brake System to determine if a condition exists where the drive wheels have lost traction. In this event, Automatic Traction Control will reduce the torque supplied to the wheels and brake, the wheel that is spinning too fast. The operator can disable Automatic Traction Control using the Automatic Traction Control Disable switch for those conditions where wheel spin is desired.

WHILE IN THE STATION

Parking Vector in the Station Bay

The procedure for how to leave the Vector between calls will depend on a number of factors. Your Standard Operating Procedure should be developed to.

- Shorten the time from call to departure.
- Optimize the State of Charge before each response.
- Keep the on-board 12 volt load active if desired (radios, flashlight chargers, etc.)
- Keep the Electric Vehicle batteries at their optimal temperature.
- Avoid 12 volt battery drain.

Charging While Parked in the Station

Charge Limit

Set the Charge Limit to 85% and leave it there. With this setting the charger will target 85% SOC. This will provide plenty of power for multiple typical responses back-to-back without charging. It will also allow the motors to develop good auxiliary stopping power during brake regeneration.

Charge Plug Connected

Anytime the Vector is returned to the station bay it can be plugged into the charger. With a low SOC the charger will begin charging at a high current flow. As the SOC approaches the charge limit, the current flow will decrease. Once the SOC limit is reached, the charger will provide only enough current to replace whatever is being used by the vehicle (current draw from step lights, radio equipment, Electric Vehicle controllers, etc).

POWER Switch ON

By leaving the POWER switch ON the High Voltage Electric Vehicle batteries will remain on-line. They will continue to top-up the 12 Volt batteries. They will also supply power to the Battery Thermal Management System, ensuring that the batteries are at the optimum temperature based on the season.

RUN Switch OFF

If the Charge Plug is connected, the vehicle cannot be placed in Drive or Reverse, but it is still good practice to place the RUN switch in the OFF position anytime the truck is parked inside a building. By leaving the RUN switch OFF, the risk of inadvertently moving the vehicle will be minimized. It will also prevent the Range Extender engine from starting.

NOTICE

With the POWER switch ON there will be certain 12V electrical draws that will continue. This may include marker lights, ground lights, air conditioning (if turned ON), etc.

If you wish to have these features turned off while you are plugged in at the station, you may turn the POWER Switch OFF (either before or after plugging in the charger). But you MUST remember to turn the POWER switch back ON before you unplug from the charger.

If you forget to turn the POWER switch ON before you unplug from the charger then the truck will begin to power down. If you then then quickly turn the POWER switch ON (in preparation for driving out of the station), while the electronics are powering down, you will risk the electronics hanging up. They will not have had sufficient time to shut down properly before you are asking them to wake again. This can cause the display screen(s) to lock with a blank or start-up screen. If this happens

- **Place the POWER switch in the OFF position**
- **Cycle the battery disconnect switch OFF for 20 seconds then turn it ON again.**
- **Turn the POWER switch back ON.**

⚠WARNING

Engine Start Hazard. Always keep the apparatus on the charger or turn the RUN switch OFF when in the station. With the RUN switch OFF the REx Range Extender engine will never start. Running the engine in the station without an exhaust extractor will expose personnel to diesel fumes.

Taking Vector out of Service

When Vector is plugged into a charger, the POWER switch can be left ON and the 12V batteries will stay fully charged. If the Vector is taken out of service and off the charger, do the following.

- ☐ RUN Switch OFF
- ☐ POWER Switch OFF
- ☐ BATTERY SAVER RELAY OFF

This will isolate the 12 V batteries and keep them from discharging due to the load from any devices that are connected directly to the 12 V system (USB ports, battery chargers, radios, etc..) Failing to follow this procedure will result in dead 12 batteries, all of which will need to be charged before the Vector will power ON.

Daily Power-OFF Cycle

Just like your computer, Vector will behave best if it is occasionally rebooted. By performing a complete power down and restart daily, the memory cache on the electronics will be reset. A power down will also trigger the telematics system to begin uploading data to the cloud so that it is available for remote analysis.
To perform a daily power cycle, complete the following.

- ☐ Charge Plug Disconnected
  - Ensure that the Charge Plug is not connected to the vehicle.
- ☐ RUN Switch OFF
- ☐ POWER Switch OFF
  - Leave the POWER switch OFF and wait for 30 seconds to make sure that all the electronics have gone to sleep.
- ☐ POWER Switch ON
  - Turn the POWER switch back ON and observe the displays. Check that there are no fault indications on the driver display.
- ☐ Charge Plug Connected
  - Follow the procedure for connecting the Charge Plug and initiating the charge sequence.

NOTICE

The time it takes for Vector to shut down the electronics varies. The electronics should be allowed to shut down completely before starting it again. The following table indicates the approximate time it takes to shut down in various conditions.

Vector Shut-Down Timing			
Shutdown Initiation	**RUN Switch**	**Range Extender Engine State**	**Time to Shut Down (s)**
Power Switch OFF	**OFF**	**OFF**	**9**
Power Switch OFF	**OFF**	**Running**	**28**
Power Switch OFF	**ON**	**OFF**	**11**
Power Switch OFF	**ON**	**Running**	**28**
Charger Plug Removed	**ON or OFF**	**OFF or Running**	**31**

Weekly Deep Power-OFF Cycle

The Daily Power-OFF Cycle is useful for all the reasons stated above, but it does not completely shut down all the electronics as there is still 12 volt power connected. It is good practice to perform a deep shut-down once a week. This procedure allows the power controller and the Electric Vehicle batteries to reset and will help keep the Electric Vehicle Battery State of Charge more accurate.

To perform a weekly power cycle, complete the following.

- ☐ Charge Plug Disconnected
  - Ensure that the Charge Plug is not connected to the vehicle.
- ☐ RUN Switch OFF.
- ☐ POWER Switch OFF
  - Leave the POWER switch OFF and wait for 30 seconds to make sure that all the electronics have gone to sleep.
- ☐ 12 Volt Battery Saver Relay OFF
  - Place the Battery Saver Relay in the OFF position and wait for 30 minutes.
- ☐ 12 Volt Battery Saver Relay AUTO/REM
  - Return the Battery Saver Relay to the AUTO/REM position.
- ☐ POWER Switch ON
  - Turn the POWER switch back ON and observe the displays. Check that there are no fault indications on the driver display.
- ☐ Charge Plug Connected
  - Follow the procedure for connecting the Charge Plug and initiating the charge sequence.

NOTICE

If you receive a call to respond while in the middle of this procedure simply cut the wait time short, return the controls to their operational settings, and respond to the call. This procedure, while good practice, is not essential for the operation of the vehicle.

BATTERY THERMAL MANAGEMENT SYSTEM

Vector uses lithium battery chemistry to provide Electric Vehicle power. Lithium batteries can only operate efficiently in a narrow range of temperatures. The Electric Vehicle batteries create their own heat when they are supplying energy and produce more heat when they are being charged. The battery packs have a lot of thermal mass, and if they leave the station warm, they will tend to stay warm as the vehicle is operated, even in cold weather. If they start out cool, they will warm slowly as they are used or charged. The Battery Thermal Management System will run as needed to add or remove heat as needed.

- **Heating Mode** - Battery Thermal Management System will begin warming when the lowest cell temperature drops below 50 degrees F (10 degrees C). The heater will run until the lowest cell temperature increases to 59 degrees F (15 degrees C).
- **Cooling Mode** - Battery Thermal Management System will begin cooling when the highest cell temperature increases above 90 degrees F (32 degrees C). The chiller will run until the highest cell temperature drops below 81 degrees F (27.2 degrees C). If the chiller compressor has not been running for at least 10 minutes, it will continue to run until the 10 minute period has been reached.
- **Winter Battery Temperature Preconditioning (While charging)** - During cold seasons when the weather consistently drops below 35 degrees F (1.6 degrees C), place the Battery Thermal Management System in WINTER Mode. This mode warms the batteries to nearer their warmer side of their operating range 81 degrees F (27.2 degrees C)] when plugged into a charging station. This ensures that the Electric Vehicle batteries have a greater amount of thermal energy when they venture into the colder ambient temperature and will require less energy to keep them warm during operation.
- **Summer Battery Temperature Preconditioning (While charging)** - During hot seasons when the weather consistently rises above 80 degrees F (26 degrees C), the apparatus should be placed in SUMMER mode. In this mode the Battery Thermal Management System will chill the batteries to the lower side of their operating range 59 degrees F (15 degrees C) whenever the apparatus is plugged into a charging station. This will pre-condition the Electric Vehicle Batteries so that the Battery Thermal Management System does not need to work so hard to keep them cool during operation.
- **Battery High Temperature Protection** - If the Battery Thermal Management System fails and the Electric Vehicle batteries become too warm (above 100.4 degrees F (38 degrees C)) the vehicle will begin to enter a derate state. This will be indicated by the Turtle Icon on the driver display. For each 1.8 degrees F (1.0 degrees C)) that the battery temperature rises above 100 degrees F (37 degrees C)) the Electric Vehicle motors will lose 7% of their operating torque. This is necessary to slow the heating of the batteries and prolong their operation. If the batteries reach 127 Degrees F (53 degrees C) the apparatus will cease to function to preserve the Electric Vehicle batteries.

RANGE EXTENDER OPERATION

Range Extender Engine Startup

The Range Extender starts and will run at idle for a few seconds to ensure that oil is circulating before a load is applied. Then the engine speed will increase to approximately 1750 rpm and remain at that speed until it shuts down again. Generator output will increase gradually. Depending on the system condition.
The maximum power generated will depend on a number of factors including.

- State of Charge.
- Battery Temperature.
- Generator Motor Temperature.

Range Extender Engine Operation Criteria

The Range Extender Engine operation requires the following.

- POWER ON.
- RUN ON.
- Charge Mode Auto, Manual, or Service Modes (depending on desired function).
- Diesel Fuel Sufficient for operation.
- External Charger Not connected.

Automatic Charging

With the Charge Mode set to AUTO, the Range Extender Engine) will start automatically whenever the Electric Vehicle Battery State of Charge drops to 15%. The Range Extender Engine will charge the Electric Vehicle batteries until they reach 50% State of Charge and then it will shut off automatically.
Range Extender Engine will not start or continue to run if.

- Fuel is low.
- Charge Mode is set to INHIBIT.
- External charge plug is connected.
- There is an High Voltage System Fault.
- Cab is not down and locked.

Manual Charging

The Range Extender Engine can be started by the operator by toggling to Charge Mode MANUAL on the Range Extender Engine menu. MANUAL mode is intended for those times when it is desired to charge the Vector and a charging station is not accessible. The Range Extender Engine can only be started in MANUAL mode if the State of Charge is below 85%. Once started the Range Extender Engine will continue to charge until the State of Charge reaches 90% and then it will stop automatically. If left in the MANUAL mode, the Range Extender Engine will start automatically again if the State of Charge drops below 85%.

Charging Control from Pump Control Display

The Range Extender Engine can be controlled by the operator from the Pump Control Display. To start the Range Extender Engine, first select MANUAL CHARGE icon. Then press the Range Extender Engine Start icon. The Range

Extender Engine can be shut down from the Pump Control Display by pressing Range Extender Engine Stop, or Auto Charge.

NOTICE

The Range Extender Engine will not start from the Pump Control Display if Charge Mode Inhibit is selected from the Driver Control Display in the cab.

Operating at a Scene

When on a response scene it is best to leave the Range Extender Engine in Charge Mode AUTO with the RUN switch ON. This way you can work as you wish knowing that if the Electric Vehicle battery State of Charge drops too low the Range Extender Engine will come on automatically, generating sufficient power to keep you working and charging the batteries at the same time. If you are at a scene where you are inside a building, or where running the Range Extender Engine would be disruptive, simply leave the RUN switch OFF, or select Charge Mode Inhibit on the Range Extender Engine menu. Just keep in mind that you will need to keep an eye on the State of Charge and ensure that you can plug into an external charger or run the Range Extender Engine before the State of Charge drops to 0%.

Cab Tilt Interlock

The Range Extender Engine will only charge when the cab is down. If you lift the cab with the Range Extender Engine running in the manual charge mode it will shut down. The Range Extender Engine will automatically start again when the cab is lowered.

HOT CLIMATE OPERATION

Operating the Range Extender Engine in hot weather for extended periods can cause the generator rotor to increase in temperature. If the rotor core temperature exceeds 110 degrees C (230 F) the generator will reduce its output to avoid internal damage. If this occurs during charging the batteries will simply take a little longer to reach the desired State of Charge level. If this occurs while pumping, watch the charge indicator on the pump panel. If the charge indicator is green, then the generator is still keeping up with the pump demand. If the charge indicator is brown, you can continue to pump on a combination of battery power and generator output. When the State of Charge drops to 15% you should consider reducing pump output until the charge indicator shows a bit of green. This means that the Range Extender Engine generator is again keeping up with the pump demand.

TILTING THE CAB

Before raising the cab, review and follow the instructions found in the Safety Section of this manual.

Raising the Cab

1. Locate the cab tilt controls (typically behind an access panel on the right side pump panel).
2. Hold the Cab Tilt Control in the CAB RAISE position until the cab is fully raised and the Safety Latch falls into place.
3. Hold the Cab Tilt Control in the CAB LOWER position to lower the cab slightly and lock the Safety Latch in place.

Lowering the Cab

1. Hold the Cab Tilt Control to raise the cab slightly until the Safety Latch can be released.
2. Pull the Safety Latch Release to swing the latch away from the lift cylinder.
3. Hold the Cab Tilt Control in the LOWER position until the cab is fully lowered. Continue to hold the Cab Tilt Control for 3 seconds to ensure the cab latch is locked in place.
4. Ensure the Cab Ajar alert is not active.

MAXIMIZING RANGE

Economical Mode

Economical Mode conserves some battery capacity by reducing the power available for acceleration. In Economical Mode the Vector will have slightly less pickup and will be more sluggish during hill climbing.

Climate Control

Cab heating and air conditioning uses Electric Vehicle battery power. Extend your Electric Vehicle range by avoiding the use of these features during moderate climate conditions.

Avoid Aggressive Driving

Accelerate and brake gently to get the most out of your Electric Vehicle battery range. Unnecessary “Jack Rabbit” starts consumes more power than accelerating smoothly and moderately. Plan your stops so that you use the brake regeneration as much as possible. This will conserve Electric Vehicle battery capacity and lengthen the life of your brakes at the same time.

Winter/Summer Mode

The Vector Battery Thermal Management System will precondition Electric Vehicle battery temperature for best operation when the vehicle is plugged in and charging. Select the proper mode based on the climate conditions.

- Select WINTER MODE for those times when the outside temperature is expected to be below 50 degrees F (10 degrees C).
- Select SUMMER MODE for those times when the outside temperature is expected to be over 80 degrees F (26 degrees C).

MAXIMIZING BATTERY LIFE

Lithium battery life is influenced by a number of variables, but there are three main conditions that can prolong life significantly.

Temperature

The Vector lithium batteries like to operate between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C). Keeping them in this range ensures good performance and increases their life. The Vector Kilowatts system will keep the batteries in this range as long as the POWER switch is ON, and/or the Vector is plugged into a functioning Combined Charging System fast charger. To help your batteries stay at a correct operating temperature, always plug it in to the fast charger when at the station, and leave the POWER switch ON when you are on a response.

Charging Rate

Lithium batteries do not like to be charged too rapidly. Rapid charging increases the internal temperature of the battery cells. Vector software programming limits the rate at which the batteries are charged, whether that charging is coming from the fast charger, the range extender generator, or from brake regeneration.
This is built into the Vector control systems and there is nothing that the operator needs to do.

Charging and Discharging Limits

Vector Lithium battery life is reduced whenever they are charged completely or discharged completely. To maximize battery life, Vector programming limits charging to 88% of the total capacity, and limits discharging to 8% of total capacity. A 0% state of charge on the vehicle display is actually 8% remaining, and 100% state of charge on the vehicle display is actually 88% of full capacity. Two things that you can do to increase your battery life further.

- Leave the Range Extender Engine mode on CHARGE MODE AUTO. This will ensure that the batteries get charged when they are at 15% State of Charge. Avoid using the CHARGE MODE INHIBIT function unless necessary so that the State of Charge will not drop below 15%.
- Set the CHARGE LIMIT to something less than 100%. This will give the batteries an additional buffer and further extend their life. 85% charge limit is a good compromise if it will suit your response duty cycle.

VECTOR NOISES

Without the noise from a diesel engine, other noises may be more noticeable. These include suspension squeaks, Self Contained Breathing Apparatus seat bracket rattles, and other noises usually drowned out by the diesel. In addition, Vector has unique components that will make their own noises when operating normally.

Auxiliary Motor

The auxiliary power steering and air compressor motor will run periodically if the air brake pressure drops below 85 psi. (586.05 kPa).

Electric Vehicle Coolant Pumps

The Electric Vehicle Coolant pumps are variable speed devices that will match the coolant flow rate to the cooling demand. When spinning slowly they will not make much noise.

Air Conditioning Compressor

Vector Climate Control functions operate anytime the POWER switch is ON. The air conditioning compressor will cycle on and off as required if the HVAC controls are set to CLIMATE MODE – A/C , DEFROST, or DEFOG.

Cab Heater – Electric

Vector Climate Control functions operate anytime the POWER switch is ON. The cab coolant pump will cycle on and off as required if the HVAC controls are set to CLIMATE MODE - HEAT.

Cab Heater – Diesel-Fired (Optional)

Vector Climate Control functions operate anytime the POWER switch is ON. The fuel-fired heater burner will run and the cab coolant pump will cycle on and off as required if the HVAC controls are set to CLIMATE MODE - HEAT.

Radiator Fans

The fans located at the front of the radiator may run when the vehicle is stationary and the range extender is OFF. When the Electric Vehicle components cool to below their set-points, the fans will turn off.

Battery Thermal Management System

The Battery Thermal Management System has a compressor that will cycle on and off as required to cool the batteries. It also has fans to blow ambient air across the heat exchangers. The Battery Thermal Management System operates based on the cell temperatures in the batteries, but only when it needs to. You can observe whether the Battery Thermal Management System is functioning in heating or cooling mode by watching for the snowflake or heat wave icons within the battery temperature gauge on the driver's display.

Auxiliary Motor

The auxiliary power steering and air brake motor will run continuously for up to 12 minutes after the RUN switch is turned ON. This is to get the system up to temperature and to circulate oil in the air brake compressor and avoid condensation in the air brake lines.

Noise Generator

The noise generator located in the front bumper will make a simulated engine noise when the vehicle is placed in D or R. This noise will stop when the vehicle speed exceeds 12 mph (20 kph).

FIRE PUMP CONTROLS DESCRIPTION

OVERVIEW

This section of the operator's manual provides controls descriptions and operating guidelines for the operation of the electric vehicle control systems that power and provide control for an onboard fire pump. For more complete information about fire pump controls and operation, see the "Pump Operation and Service Manual" for your apparatus.

PUMP CONTROLS DESCRIPTION

Pump Control Display

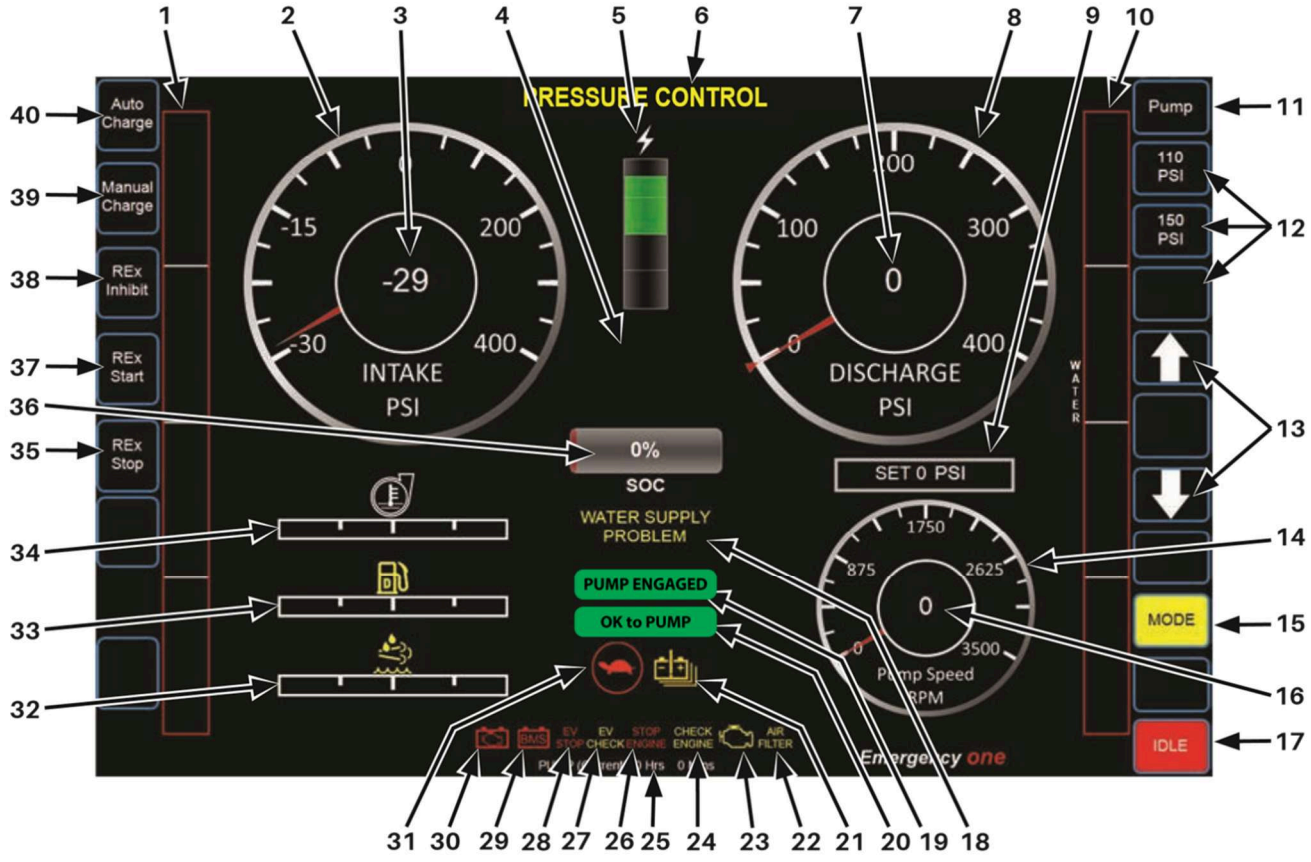
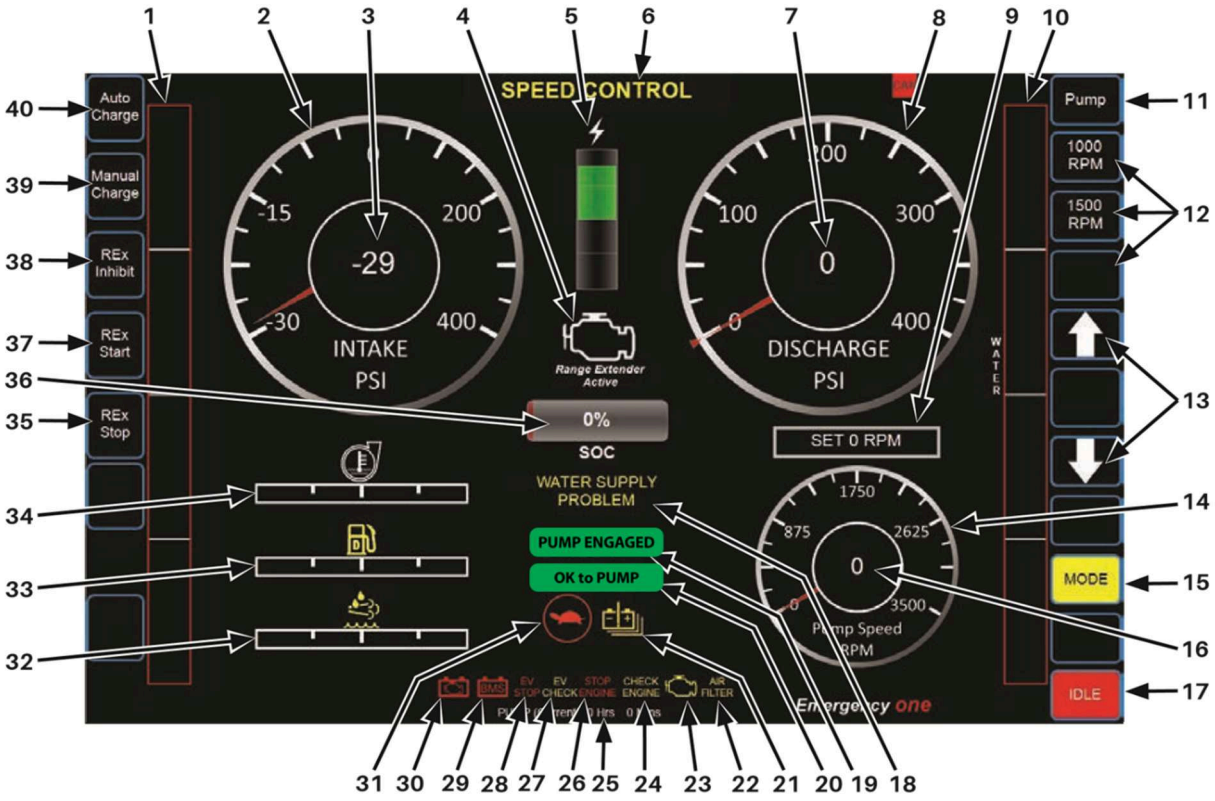


Figure 5-1. Pressure Control Display

FIRE PUMP CONTROL DESCRIPTION



Speed Control Display

1. **Foam Level** - Indicates the amount of solution in the foam tank.
2. **Master Intake Pressure Gauge** - Displays intake pressure. Negative values indicate a vacuum.
3. **Master Intake Pressure Digital Indication** - Displays intake pressure digitally. Negative values indicate a vacuum.
4. **Range Extender Active** - Indicates the state of the Range Extender Engine.

    - Flashing. Range Extender Engine operation has been requested.
    - Solid. Range Extender Engine is operating.
    - Solid with X. Range Extender Engine is inhibited.

5. **Power Bar** - The Power Bar indicates whether there is power flowing into or out of the Electric Vehicle batteries. This will be the total of power from the batteries, the charging station and/or the range extender.

    GREEN bar upward indicates that the Electric Vehicle batteries are being charged (There is more power coming onto the system by a charge source or the range extender than there is power being consumed by the traction motors and the chassis load).

    BROWN bar going down indicates that power is being drawn from the Electric Vehicle battery system (There is more power being consumed through pumping and chassis load than the charging source or range extender generator can keep up with).

    NO BAR indicates that the power being consumed and the power from the generator or charging station is balanced.

6. **Mode Indication** - Indicates with mode the pump control is set to, Speed or Pressure control.

7. **Master Discharge Pressure Digital Indication** - Displays discharge pressure digitally.
8. **Master Discharge Pressure Gauge** - Displays discharge pressure.
9. **SET Box** - Indicates the discharge pressure being requested (when in Pressure Control MODE) or the pump speed being requested (when in Speed Control Mode).
10. **Water Level** - Indicates the amount of water remaining in the water tank.
11. **Pump** - Turns the Pump ON. Pump spins at idle until commanded otherwise.
12. **PRESET Buttons** - Press to command the pump to produce the displayed pressure or pump speed.
13. **Up or Down Arrows** - Increases or Decreases the discharge pressure setting (in Pressure Control mode) Increases or Decreases the pump speed (in Pump Speed Control mode).
14. **Pump Speed Gauge** - Displays pump speed in RPM.
15. **MODE** - Press to change the method of pump control.

    - **PRESSURE CONTROL**. the system maintains a constant pressure by controlling the pump speed automatically based on the value of the pump pressure being requested.
    - **SPEED CONTROL**. The system maintains the pump at a constant speed (rpm).

16. **Pump Speed Digital Indication** - Displays pump speed digitally in RPM.
17. **IDLE** - Returns the pump speed to IDLE.
18. **Water Supply Problem** - Indicates that the operator is asking for a lower water pressure than the pump can provide because the pressure from the water source is too high.
19. **Pump Engage** - Indicator illuminates when the pump transfer case has mechanically shifted into pump mode.
20. **OK To Pump** - Indicator illuminates when the water pump is engaged, Park Brake is selected, and the drive motors are prepared to spin the pump.
21. **Electric Vehicle Battery Alert** - Indicator will illuminate with certain faults in the High Voltage batteries. One fault may be that the contactors in one of the battery packs has failed to close. If this occurs, expect less acceleration and less speed on hills. Place vehicle on charger to rebalance.
    The Electric Vehicle Battery Alert icon will reset when the POWER button is cycled as long as the cause of the fault has been corrected.

CAUTION

If the Electric Vehicle Battery Alert illuminates have the fault diagnosed and corrected at the next opportunity.

22. **Range Extender Air Filter Warning Indicator** - Indicator will illuminate when the air filter requires replacement.
23. **Range Extender Malfunction Indicator Light (or Lamp)** - Indicator will illuminate YELLOW if the range extender engine Electronic Control Unit detects an emissions related fault.

CAUTION

Operating the Range Extender Engine with a Malfunction Indicator Light (or Lamp) illuminated means the engine may be exceeding emissions limits. Have the fault diagnosed and corrected at the next opportunity.

24. **Range Extender CHECK ENGINE Indicator** - Indicator will illuminate YELLOW if the range extender engine Electronic Control Unit senses a noncritical fault.

CAUTION

The CHECK ENGINE indicator illuminated means the engine is not operating within ideal conditions. Have the fault diagnosed and corrected at the next opportunity.

25. **Pump Hours** - Displays alternates between the total number of hours that the pump has been operating (total), and the time the pump has been operating since the last power cycle (current).
26. **Range Extender STOP ENGINE Indicator** - Indicator will illuminate if the range extender engine Electronic Control Unit senses a critical fault.
27. **Electric Vehicle CHECK** - Indicator will illuminate if the High Voltage control system Electronic Control Unit or High Voltage Battery Management System detects a fault.
    The Electric Vehicle CHECK light will reset when the POWER button is cycled as long as the cause of the fault has been corrected.

CAUTION

If the Electric Vehicle CHECK illuminates have the fault diagnosed and corrected at the next opportunity.

28. **Electric Vehicle STOP** - Indicator will illuminate if the High Voltage control system Electronic Control Unit or High Voltage Battery Management System detects a CRITICAL fault
    The Electric Vehicle STOP light will reset when the POWER button is cycled as long as the cause of the fault has been corrected.

CAUTION

If the Electric Vehicle STOP illuminates, remove the apparatus from service and repair before continuing operation.

29. **Battery Management System Battery Voltage Out of Range** - Indicator will illuminate if the High Voltage Battery Management System battery voltage falls below 11.8 volts or rises above 14.5 volts.

CAUTION

If the Battery Management System Battery Voltage out of Range illuminates, remove the vehicle from service and repair before continued operation.

30. **Chassis Battery Voltage Out of Range** - Indicator will illuminate if the chassis battery voltage falls below 11.8 volts or rises above 14.5 volts.

CAUTION

If the Chassis Battery Voltage out of Range illuminates, remove the vehicle from service and repair before continued operation.

31. **Derate Indicator** - The Derate icon indicates that the Electric Vehicle traction motors are in a derated condition. If this occurs, expect less acceleration and less speed on hills and less pumping capability. The icon will disappear when the derate condition has is no longer in effect.
32. **Diesel Emissions Fluid Level** - This gauge displays Diesel Emissions Fluid level remaining in the Diesel Emissions Fluid tank.

NOTICE

The gauge will only indicate the correct level when the Range Extender engine is running. When the engine is not running, Diesel Emissions Fluid level gauge will indicate the level of the Diesel Emissions Fluid from the last time the engine was running.

Diesel Emissions Fluid Level	
Indicators	**Condition**
Diesel Emissions Fluid Solid	**Diesel Emissions Fluid Level low**
Diesel Emissions Fluid Flashing	**Diesel Emissions Fluid Level below critical level**
Diesel Emissions Fluid Flashing + Check Engine	**Diesel Emissions Fluid Level critically low**
Diesel Emissions Fluid Flashing + Check Engine + Stop Engine	**Engine has been shut down or has idled for 20 hours after the Diesel Emissions Fluid tank has been run dry.**

NOTICE

Indicator will reset once Diesel Emissions Fluid tank is refilled.

33. **Fuel Level** - This gauge displays the amount of diesel fuel remaining in fuel tank. The fuel tank indicator will illuminate YELLOW if fuel tank level falls below 1/8 tank.
34. **Pump Temperature Gauge** - Displays water pump outlet temperature. The icon changes to yellow when the temperature reaches 120°F (49°C).
35. **Range Extender Engine STOP** - Pressing Range Extender Engine STOP will shut down the range extender generator.
36. **High Voltage Battery State of Charge** - This bar displays the usable state of charge of the high voltage batteries.

High Voltage Battery State of Charge	
Color	**Condition**
Green	**Usable State of Charge is above 50%**
Yellow	**Usable State of Charge is between 15% and 50%**
Red	**Usable State of Charge is below 15%**

37. **Range Extender Engine START** -Pressing Range Extender Engine Manual Start engages the starter motor to crank the engine if.

    - Parking Brake is Engaged (DRIVE MODE in N).
    - Manual Charge is selected.
    - State of Charge is within the required range.

38. **Range Extender Engine Inhibit** - Pressing Range Extender Engine Inhibit suppresses the Auto Charge and Manual Charge operation. The Range Extender Engine will not START again until one of the other modes is selected.
39. **Manual Charge** - Pressing Manual Charge icon will illuminate BLUE and engage the Range Extender Engine ignition mode. Range Extender Engine START and Range Extender Engine STOP will illuminate BLUE indicating that the Range Extender Engine can be manually started or stopped by the operator.

NOTICE

The Manual Start function will not start the Range Extender Engine unless the Electric Vehicle Battery State of Charge is below 85%.

40. **Auto Charge** - This Icon is illuminated BLUE as default. Press this button to return to Auto Charge mode from one of the other modes.

NOTICE

Once started in AUTO Mode the Range Extender Engine remains ON until the State of Charge reaches 50%. Range Extender Engine START is not functional in Auto Charge mode.

41. **Pump Priming** - Indicates that pump priming is occurring. (Not Shown).

Throttle

Throttle - Rotary control allowing the operator to adjust the requested pressure or requested pump speed by turning the knob.

PUMP OPERATION

PUMP ENGAGEMENT

Once you have positioned the apparatus at the scene, pull the PARK BRAKE but leave the RUN and POWER switches ON. Next flip the ROAD/PUMP switch to the PUMP Position.

- ☐ Park the apparatus.
- ☐ PARK BRAKE Applied.
- ☐ POWER ON.
- ☐ RUN ON.
- ☐ Toggle the ROAD/PUMP switch to PUMP.
- ☐ Chock the wheels.
- ☐ Press PUMP on the Pump Control Display.

PUMP ENGAGED This icon means that the pump transfer case has made the shift from **ROAD MODE** to **PUMP MODE**

OK to PUMP This icon means that the **RUN** switch is ON and the traction motor is ready to spin the pump.

NOTICE

There are three voice alerts associated with placing the apparatus in pump gear. "Pump Mode" indicates that you have switched the ROAD/PUMP switch to PUMP. "Water Pump Engaged" means that the pump has made the shift. "OK to Pump" means that the RUN and POWER switches are both ON, and the PARK BRAKE is engaged. All of these have to happen before the PUMP icon on the E-Pump display will function.

PUMP OUTPUT CONTROL

The pump controller can be operated in either PRESSURE CONTROL or SPEED CONTROL modes. PRESSURE CONTROL is the recommended mode because the system will always attempt to maintain the pump output at the desired pressure even with changes to inlet or discharge pressures and flows. SPEED CONTROL is available for operators who prefer to set the pump speed manually with the understanding that the system will not be controlling output pressure.

Pressure Control Mode

Pump Mode toggled to PRESSURE CONTROL mode.

- ☐ Adjust pump output pressure using one of the following methods.
  - Select one of the pump pressure PRESET icons.
  - Adjust the pump pressure using the TWISTER control.
  - Adjust the pump pressure using the UP/DOWN arrows on the display.
- ☐ Monitor the adjusted setting shown below the Master Discharge gauge on the display.

Speed Control Mode

Pump Mode toggled to SPEED CONTROL mode.

- Adjust pump output pressure using one of the following methods.
  - Select one of the pump speed PRESET icons.
  - Adjust the pump speed using the TWISTER control.
  - Adjust the pump speed using the UP/DOWN arrows on the display.
- Monitor the adjusted setting shown below the Master Discharge gauge on the display.

Discharge Pressure vs Intake Pressure

After adjusting the pump pressure or speed control it may take time for the system to catch up. This is normal so that the system does not create rapid changes in pump pressure or speed.
If the actual discharge pressure indicated on the Master Discharge gauge settles out at a lower setting than that requested it may be an indication that you have exceeded the pump and motor capabilities.

If the actual discharge pressure indicated on the Master Discharge gauge settles out at a higher setting than that requested it may be an indication that the intake pressure from the hydrant or relay pumper is higher than the requested setting. The Vector pump system cannot reduce pressure it can only increase it.

Running Short of Water while Pumping

During operation the water supply to the pump may be reduced or restricted. Conditions that can restrict water supply include.

- Water tank is empty.
- Restriction in the intake line or drafting strainer.
- Air in the intake line or pump.
- Transitioning from one water source to another.
- Insufficient water supply from the hydrant or drafting source.

Limited Water Supply Condition

If you have a condition where there is insufficient water while operating in PRESSURE CONTROL mode, the pressure governor will first attempt to maintain pressure by increasing the pump RPM. If the pressure fails to increase after increasing 300 rpm the system will switch automatically to the SPEED CONTROL mode and stay at that increased rpm. The message “WATER SUPPLY PROBLEM” will appear on the display. Manually adjust the rpm based on water conditions. Once the low water condition is resolved you can switch back to PRESSURE CONTROL mode, and continue operation.

Restricted Water Supply Condition

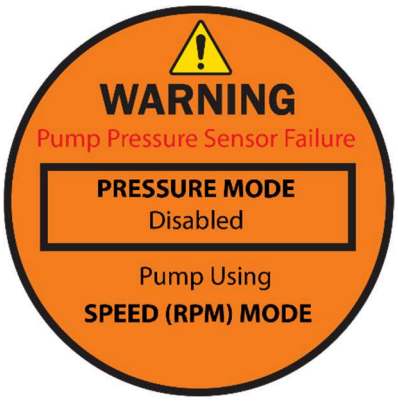
If you have a condition where there is very little water (for example the tank is quite low or the hydrant supply has a restriction) while operating in PRESSURE CONTROL mode, the pressure will drop quickly. If the pressure governor sees a drop in pressure below 45 psi. (310.26 kPa) but above 15 psi. (103.42 kPa), the governor will switch automatically to the SPEED CONTROL mode and drop to 1000 rpm. The message “WATER SUPPLY PROBLEM” will appear on the display. Manually adjust the rpm based on water conditions. Once the low water condition is resolved you can switch back to PRESSURE CONTROL mode, and continue operation.

Zero Water Supply Condition

If you have a condition where there NO water (for example the tank runs completely dry) while operating in PRESSURE CONTROL mode, the pressure will drop immediately. If the pressure governor sees a drop in pressure below 15 psi. (103.42 kPa), the governor will drop pump speed to 1000 rpm, 3 seconds later it will drop pump speed to IDLE, and then switch automatically to the SPEED CONTROL mode. The message "WATER SUPPLY PROBLEM" will appear on the display. Turn pump OFF and correct the water supply problem. Once a water supply is restored you can switch back to PRESSURE CONTROL mode, re-engage the pump, and continue normal operation.

Pressure Sensor Failure Condition

Every pressure governor needs to know the pressure or vacuum at the pump intake, and the pressure at the pump discharge. If either of these sensors fail, the pressure governor cannot operate. In the case of a pressure sensor failure the master gauge images will be replaced with a warning indication showing you that the system does not know the pump pressures, but reminding you that you can continue to pump water using the SPEED CONTROL mode. As long as the OK to Pump and Pump Engaged icons are green, the pump can be operated. Monitor the pressure on the individual discharge gauges and adjust pump speed appropriately.



ELECTRIC PUMPING DURATION

The electric pumping duration depends on the following factors.

- Intake pressure
- Discharge pressure
- Flow

The higher the discharge pressure, the more the pump needs to work and the more battery power it will consume. The higher the intake pressure is the less the pump has to work and the less battery power it will consume (higher hydrant pressure will allow the pump to run longer). The greater the flow, the more power the pump consumes.

Extended Pumping Duration

Once the battery charge capacity drops to 15% the Range Extender engine will start and begin to generate power. This is sufficient power to keep up with the following pumping scenarios.

- 1250 gpm at 150 psi. (1034.21 kPa) from draft.
- 1500 gpm at 150 psi. (1034.21 kPa) from hydrant or relay pumper providing 50 psi. (344.73 kPa) intake pressure.

Monitor the POWER BAR on the pump panel display once the Range Extender has come ON. The POWER BAR should be in the GREEN, showing that it is keeping up with the power demand. If the POWER BAR is not showing GREEN dial back on the pump demand.

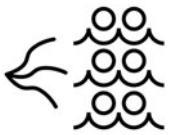
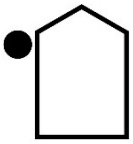
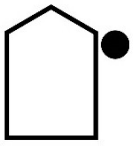
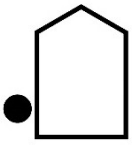
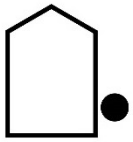
Anticipated Over-Extended Pumping Duration

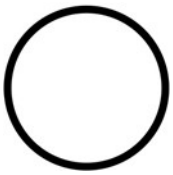
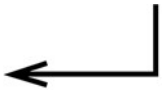
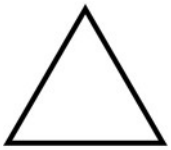
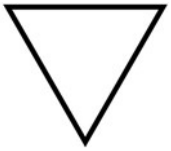
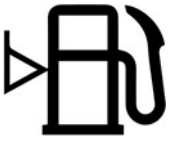
If you are faced with a scenario where you will be pumping 1500 gpm or greater from draft, the Range Extender engine should be started in manual mode as soon into the pumping event as possible. This will allow most of the pumping power to be provided by the Range Extender generator (130 Kilowatts) with the extra power required provided by the Electric Vehicle batteries. This will preserve the battery capacity and allow the Vector to pump over its normal range until the battery State of Charge drops to Zero. Once you have depleted the Electric Vehicle batteries you will need to dial back the flow to the point where the generator can keep up, something less than 130 Kilowatts. Dial back until the POWER BAR indication on the display is in the GREEN.

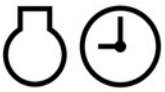
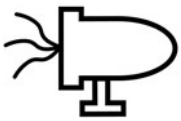
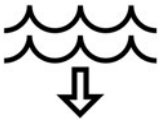
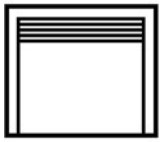
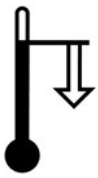
APPENDIX

Graphical Symbol Definitions

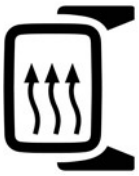
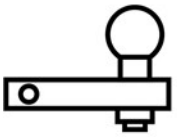
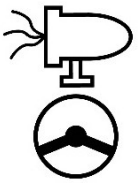
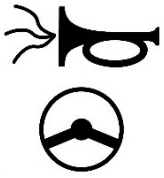
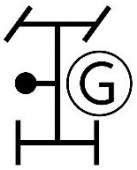
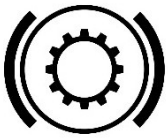
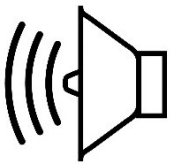
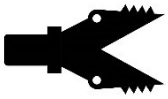
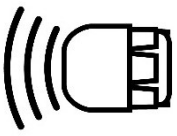
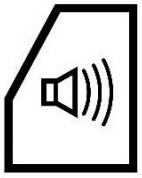
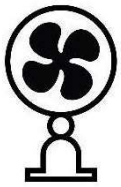
Your apparatus may use graphical symbols to indicate the function of switches, controls, gauges, or components. Study his section so you will understand the meanings of these symbols. For more in-depth explanations of the symbols refer to *TC008 Graphical Symbols for Automotive Fire Apparatus* available for download at **FAMA.org**.

Base Symbols						
 Water	 Foam Concentrate	 Foam Solution	 Powder	 Compressed Air Foam (CAF) Wet	 Compressed Air Foam (CAF) Dry	 Halotron
 Location Left Front Cab or Apparatus	 Location Right Front Cab or Apparatus	 Location Left Rear Cab or Apparatus	 Location Right Rear Cab or Apparatus			

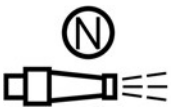
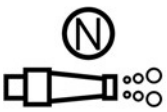
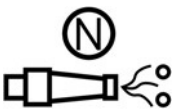
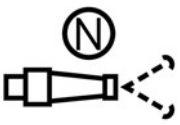
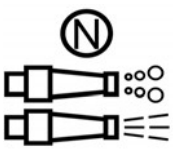
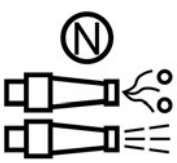
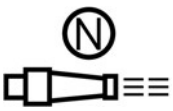
General Symbols						
On / Start	 Off / Stop	 On and Off	 Clock / Time Switch / Timer	 Fast	 Slow	 Continuously Variable-Linear
 Continuously Variable-Rotational	 Unlock or Switch Interlock	 Bell or Alarm	 Manual Operation / Manual Start	 Auto Operation / Automatic Start	 Back	 Select
 Up	 Down	 Warning	 Engine Rotational Speed	 Engine Rotational Speed-Instantaneous Decrease	 Engine Coolant	 Fuel Level

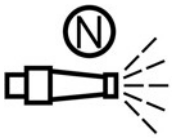
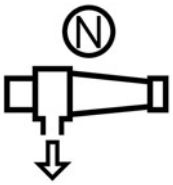
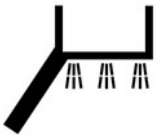
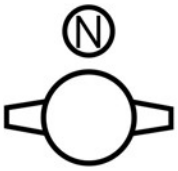
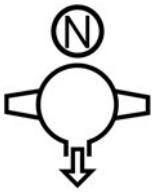
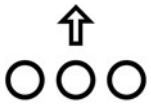
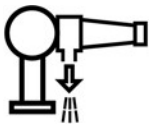
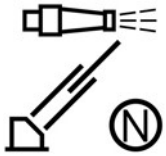
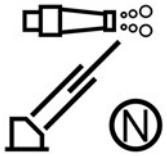
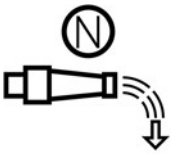
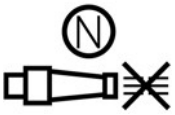
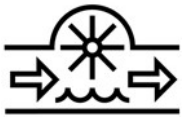
General Symbols						
 Emergency Stop	 Power Take-Off (PTO)	 Power Take-Off Engage	 Road Mode	 Engine Operating Hours	 Standby	 Breathing Air (SCBA)
 Siren Mechanical	 Horn	 Air Horn	 Foam Pressure	 Hydraulic Pressure	 Hydraulic Pump	 Air Compressor
 Radiator Re-Fill	 Emergency Power Unit	 Water Flush	 Air Purge or Drain	 Ladder Rack Down	 Ladder Rack Up	 Compartment Door Alert
 Pumper Apparatus	 Aerial Ladder Apparatus	 Suspension Front	 Suspension Rear	 Helmet Restraint	 Compartment Door	 Equipment Restraint
 Auxiliary Cooler	 Height of Vehicle Hint for Driver	 Width of Vehicle Hint for Driver	 GVWR of Vehicle Hint for Driver	 Fording Depth Water Crossing Ability	 Fording Depth Water Crossing Hint for Driver	 Video Camera
 Rear View Video Camera	 Wind Speed	 Compartment Door Open	 Apparatus Front View	 Aerial Apparatus Front View	Exterior Rear View Mirror 4-Way Adjustment	Exterior Rear View Mirror 2-Way Adjustment

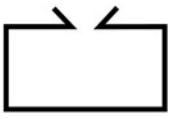
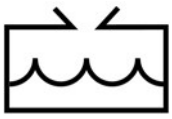
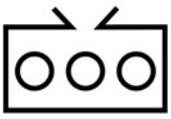
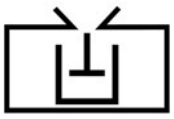
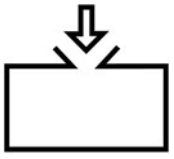
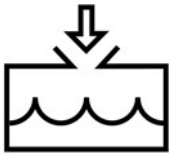
General Symbols

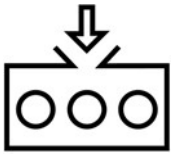
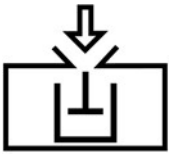
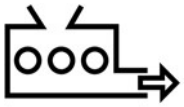
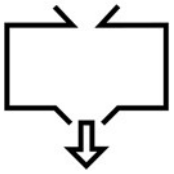
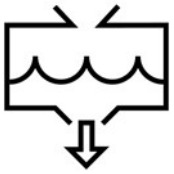
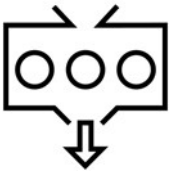
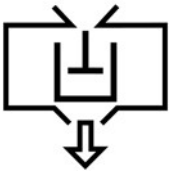
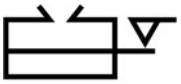
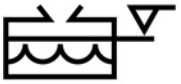
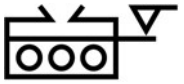
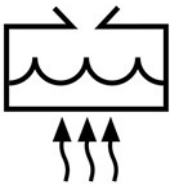
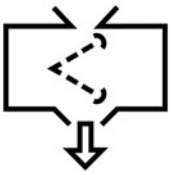
 Exterior Rear View Mirror Heat	 Engine Cooling Fan Clutch Lock	 Traffic Signal Preemption OFF	 Engine Emergency Shut-Down	 Ball Hitch or Ball Hitch Receiver	 Tanker or Tender	 Brush Truck or Mini-Pumper
 Wildland Apparatus	 Digital Alert Warning System	 Siren Brake	 Automatic Tire Chain	 Siren Operated by Steering Wheel Center Switch	 Air Horn Operated by Steering Wheel Center Switch	 Generator PTO Engage
 Air Compressor PTO Engage	 Transmission Retarder or Brake	 Engine Compression or Exhaust Brake	 Neutral	 Cab Heat	 Electronic Siren	 Electronic Siren Activated through Steering Wheel Horn Button
 Front Axle Brake Lock	 Extrication Tools	 Low Frequency Electronic Siren (Rumbler)	 AM/FM Radio, Stereo, etc.	 Engine Emergency Stop Reset	 Buzzer Sounding in Cab	 Buzzer Sounding in Tiller Cab
 Buzzer Sounding at Body	 Defog Fan					

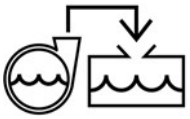
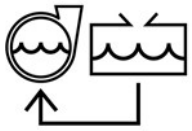
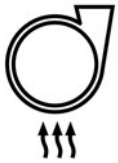
Discharge & Intake

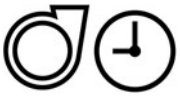
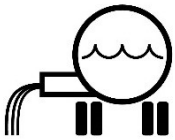
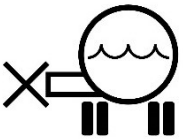
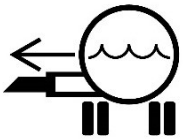
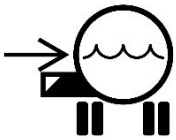
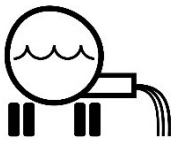
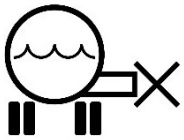
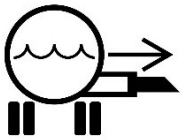
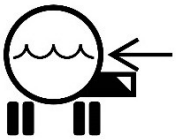
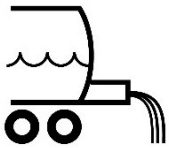
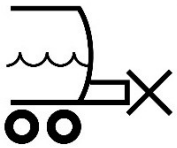
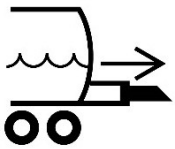
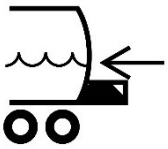
 Water Discharge	 Foam Discharge	 CAF Discharge	 Powder Discharge	 Foam or Water Discharge	 CAFS or Water Discharge	 Stream

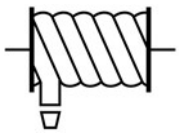
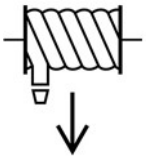
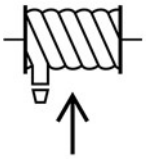
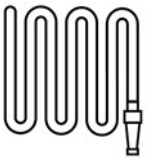
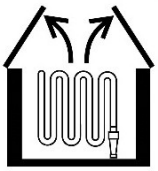
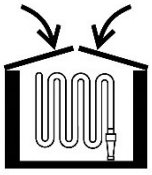
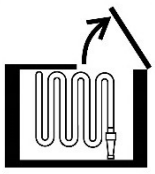
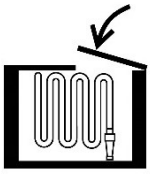
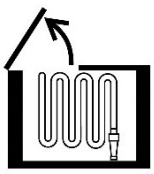
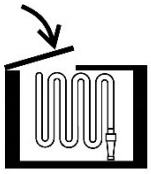
Discharge & Intake						
 Fog	 Discharge Drain or Bleeder	 Aerial Platform Water Curtain	 Pavement Cooler Discharge	 Intake	 Intake Drain or Bleeder	 Foam Intake
 Remote Monitor	 Manual Monitor	 Monitor Elevate	 Monitor Depress	 Monitor Lower	 Monitor Raise	 Monitor Rotate CCW
 Monitor Rotate CW	 Monitor Oscillate	 Monitor Stow	 Monitor Drain or Bleed	 Aerial Water Discharge	 Aerial Foam Discharge	 Aerial CAF Discharge
 Aerial Powder Discharge	 Aerial Discharge Drain	 Aerial Intake	 Shower Discharge	 Nozzle Flush	 Nozzle Off	 Water Flow Rate
 Water Flow Total						

Tank						
 Tank	 Water Tank	 Foam Tank	 Powder Tank	 Hydraulic Tank	 Tank Fill	 Water Tank Fill

Tank						
 Foam Tank Fill	 Powder Tank Fill	 Hydraulic Tank Fill	 Tank Outlet	 Water Tank Outlet	 Foam Tank Outlet	 Tank Drain
 Water Tank Drain	 Foam Tank Drain	 Hydraulic Tank Drain	 Tank Level	 Water Tank Level	 Foam Tank Level	 Hydraulic Tank Level
 Water Tank Heater	 Halotron Tank Fill	 Powder Tank Drain				

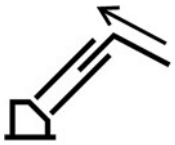
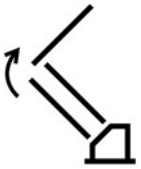
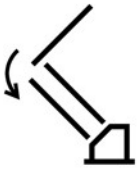
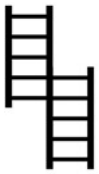
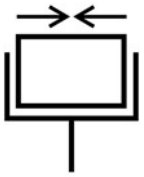
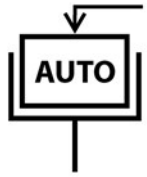
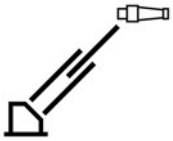
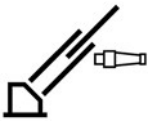
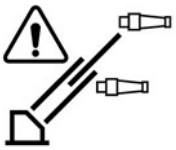
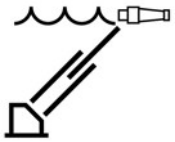
Fire Suppression Pump Functions & Features						
 Pump	 Pump Engage	 Pump Engage Manually	 Water Pump Engage	 Foam Pump Engage	 Pump Intake	 Pump Discharge
 Pump Priming	 Pump Priming	 Pump Drain	 Pump-to-Tank Valve	 Tank-to-Pump Valve	 Pump Cooling Recirculation Valve	 Pump Water Temperature
 Pump Transmission Temperature	 Water Pump Discharge Relief	 Foam Pump Discharge Relief	 Pump Low Pressure	 Pump High Pressure	 Pump Ultra High Pressure	 Pump Heater

Fire Suppression Pump Functions & Features						
 Pump Compartment Heater	 Pump Hour	 Pump Pressure Governor	 OK to Pump	 Dump Chute Left OPEN	 Dump Chute Left CLOSE	 Dump Chute Left EXTEND
 Dump Chute Left RETRACT	 Dump Chute Right OPEN	 Dump Chute Right CLOSE	 Dump Chute Right EXTEND	 Dump Chute Right RETRACT	 Dump Chute Rear OPEN	 Dump Chute Rear CLOSE
 Dump Chute Rear EXTEND	 Dump Chute Rear RETRACT	 Foam Pump	 Foam Pump OFF			

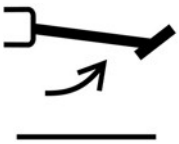
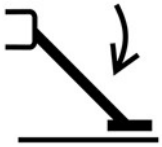
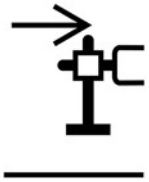
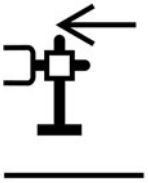
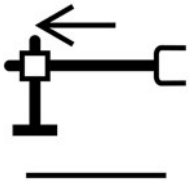
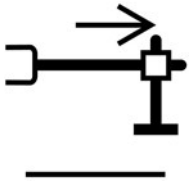
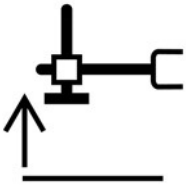
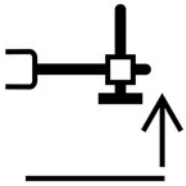
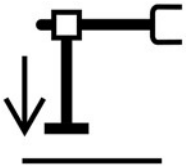
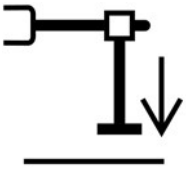
Hose						
 Hose Reel	 Hose Reel Wind Out	 Hose Reel Wind In	 Pre-connected Hose	 Hose	 Hose Restraint	 Hose Bed Cover OPEN
 Hose Bed Cover CLOSE	 Hose Bed Cover RH OPEN	 Hose Bed Cover RH CLOSE	 Hose Bed Cover LH OPEN	 Hose Bed Cover LH CLOSE		

Aerial Device						
 Aerial Extend	 Aerial Retract	 Aerial Elevate	 Aerial Depress	 Aerial Rotate CCW	 Aerial Rotate CW	 Aerial Articulate Extend

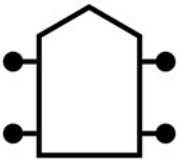
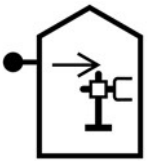
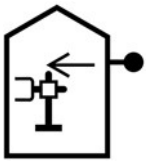
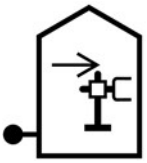
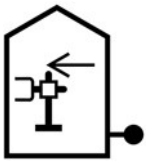
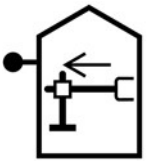
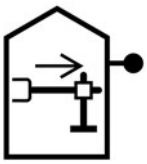
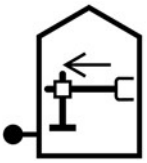
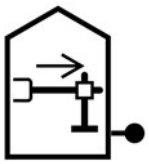
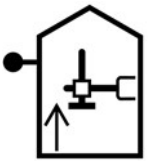
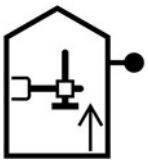
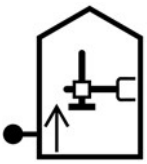
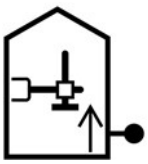
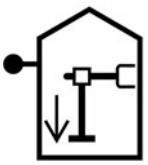
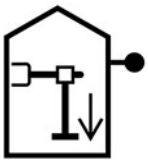
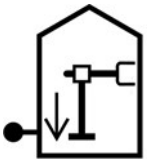
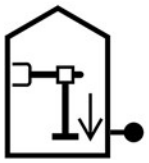
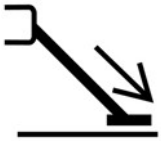
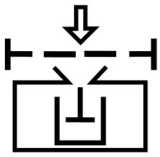
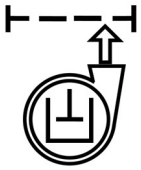
Aerial Device

 Aerial Articulate Retract	 Aerial Articulate Elevate	 Aerial Articulate Depress	 Aerial Boom Raise	 Aerial Boom Lower	 Ladder Rungs Aligned	 Aligned with Cradle
 Automatic Aerial Stowing	 Aerial Monitor Water Tower Mode	 Aerial Monitor Rescue Mode	 Movable Monitor Not Secure	 Aerial Overload	 Aerial Platform Overload	 Aerial Platform Leveling
 Aerial Platform Rotate CCW	 Aerial Platform Rotate CW	 Aerial Hours	 Aerial Power	 Aerial Device Enable	 Tip Controls Enable	 Aerial Waterway Wet
 Aerial Nozzle Angle Up	 Aerial Body Collision Alert	 Aerial Body Collision OFF	 Aerial Device Not Stowed	 Stabilizer Not Stowed	 Trailer Jackknife Warning	 Ladder Ramp Adjust

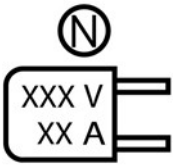
Stabilizers

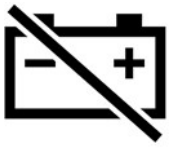
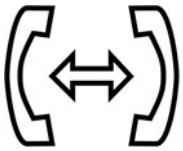
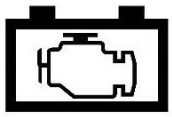
 Left Stabilizer Up	 Right Stabilizer Up	 Left Stabilizer Down	 Right Stabilizer Down	 Left Beam In	 Right Beam In	 Left Beam Out
 Right Beam Out	 Left Jack Up	 Right Jack Up	 Left Jack Down	 Right Jack Down	Stabilizer Off-Level Warning	Stabilizers Automatic Leveling

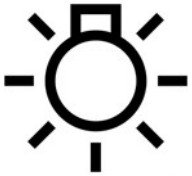
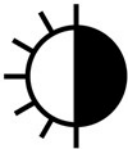
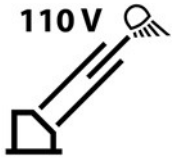
Stabilizers

 Stabilizers Manual Leveling	 Stabilizers Short-Jack Warning	 Stabilizers Set	 Stabilizers Locations	 Front Left Beam In	 Front Right Beam In	 Rear Left Beam In
 Right Rear Beam In	 Front Left Beam Out	 Front Right Beam Out	 Rear Left Beam Out	 Rear Right Beam Out	 Front Left Jack Up	 Front Right Jack Up
 Rear Left Jack Up	 Rear Right Jack Up	 Front Left Jack Down	 Front Right Jack Down	 Rear Left Jack Down	 Rear Right Jack Down	 Front Left Stabilizer Up
 Front Right Stabilizer Up	 Rear Left Stabilizer Up	 Rear Right Stabilizer Up	 Front Left Stabilizer Down	 Front Right Stabilizer Down	 Rear Left Stabilizer Down	 Rear Right Stabilizer Down
 Left Stabilizer Extend Inclined	 Right Stabilizer Extend Inclined	 Left Stabilizer Retract Inclined	 Right Stabilizer Retract Inclined	 Return Filter Blocked	 Supply Filter Blocked	

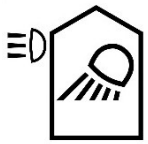
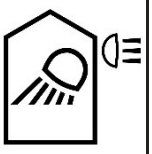
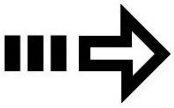
Electrical

 Battery	 Ammeter	 Generator	 Generator Pre-Heater	 Voltmeter	 Electrical Outlet	Electrical Cord Reel Outlet

Electrical						
 Battery Disconnect	 Intercom	 EV Battery Management System (BMS) Battery Indicator	 Engine Starter Battery Indicator			

Lighting						
 Panel Light	 Dome Light	 Flood Light	 Adjustable Work Light	 Reading Light	 Engine Compartment Light	 Pump Compartment Light
 Hose Bed Light	 Front Scene Light	 Rear Scene Light	 Left Side Scene Light	 Right Side Scene Light	 Perimeter Ground Lights	 Elevating Light
 Elevating Light Raise	 Elevating Light Lower	 Elevating Light Elevate	 Elevating Light Depress	 Elevating Light Rotate CCW	 Elevating Light Rotate CW	 Elevating Light Stow
 Aerial Base Light	 Aerial Tip Light	 Aerial Ladder Climbing Light	 Day Night Switch	 Low Level Interior Illumination	 Aerial Tip Light Line Voltage	 Aerial Tip Light Low Voltage
 Blocking Mode Night	 Platform Bucket Bottom Lights	 Platform Bucket Front Lights	 Platform Bucket Side Lights	 Emergency Master Lighting	 Elevating Light Behind Cab Left Side	 Elevating Light Behind Cab Right Side

Lighting

 Elevating Light Rear Body Left Side	 Elevating Light Rear Body Right Side	 Warning Light-Front	 Warning Light-Side	 Warning Light-Rear	 Scene Light-Front	 Scene Light-Rear
 Alley Light Left Side	 Alley Light Right Side	 Scene Light Left Side	 Scene Light Left Front	 Scene Light Left Rear	 Scene Light Right Side	 Scene Light Right Front
 Scene Light Left Rear	 Headlamp Wig-Wag	 Warning Light Mechanical Spinning	 White Warning Lights OFF	 Warning Light Single Front	 Compartment Light	 Light Bar
 Brow Light Narrow Beam	 Brow Light Wide Beam	 Headlights Flashing	 Docking Lights	 Command Light Green	 White Warning Lights	 Brow Light Spot Beam
 Rear Cab Scene	 Scene Light – PS Rear	 Scene Light – DS Rear	 Traffic Advisor Stick Split	 Traffic Advisor Left	 Traffic Advisor Right	 Scene Light Master

Foam & CAFS

 Foam Concentrate Injection	 Foam Concentrate Injection Rating by Percent	 Foam Concentrate Injection ON	 Foam Concentrate Injection OFF	 Foam Concentrate Injection ON-OFF	Foam Concentrate and Air Injection	Foam Concentrate and Air Injection ON

Foam & CAFS						
 Foam Concentrate and Air Injection OFF	 Foam Concentrate and Air Injection ON-OFF					