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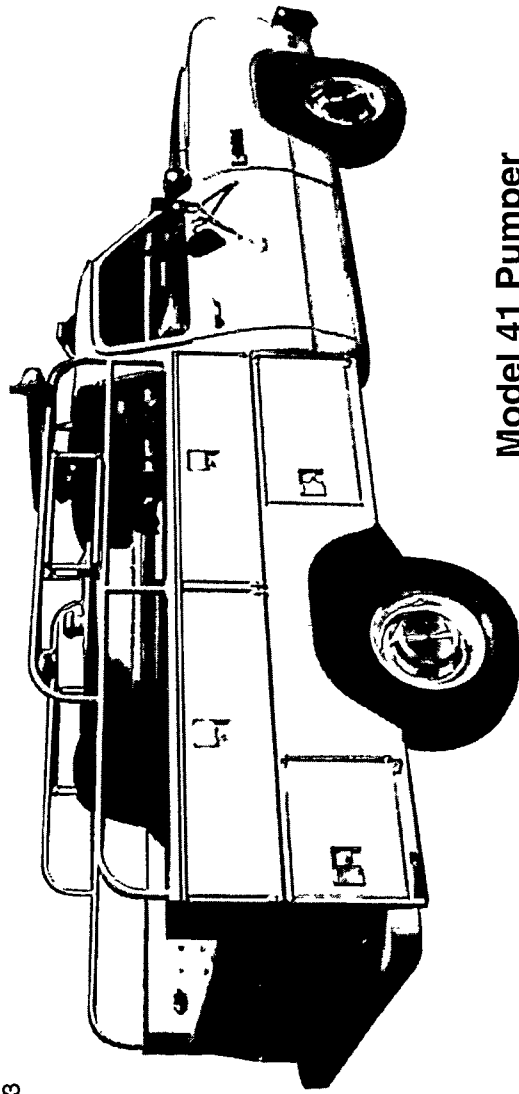
Forest Service
Pacific Southwest
Region

San Francisco
California

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Models 10, 20/21, 41 Pumper Operator Guides



Model 41 Pumper

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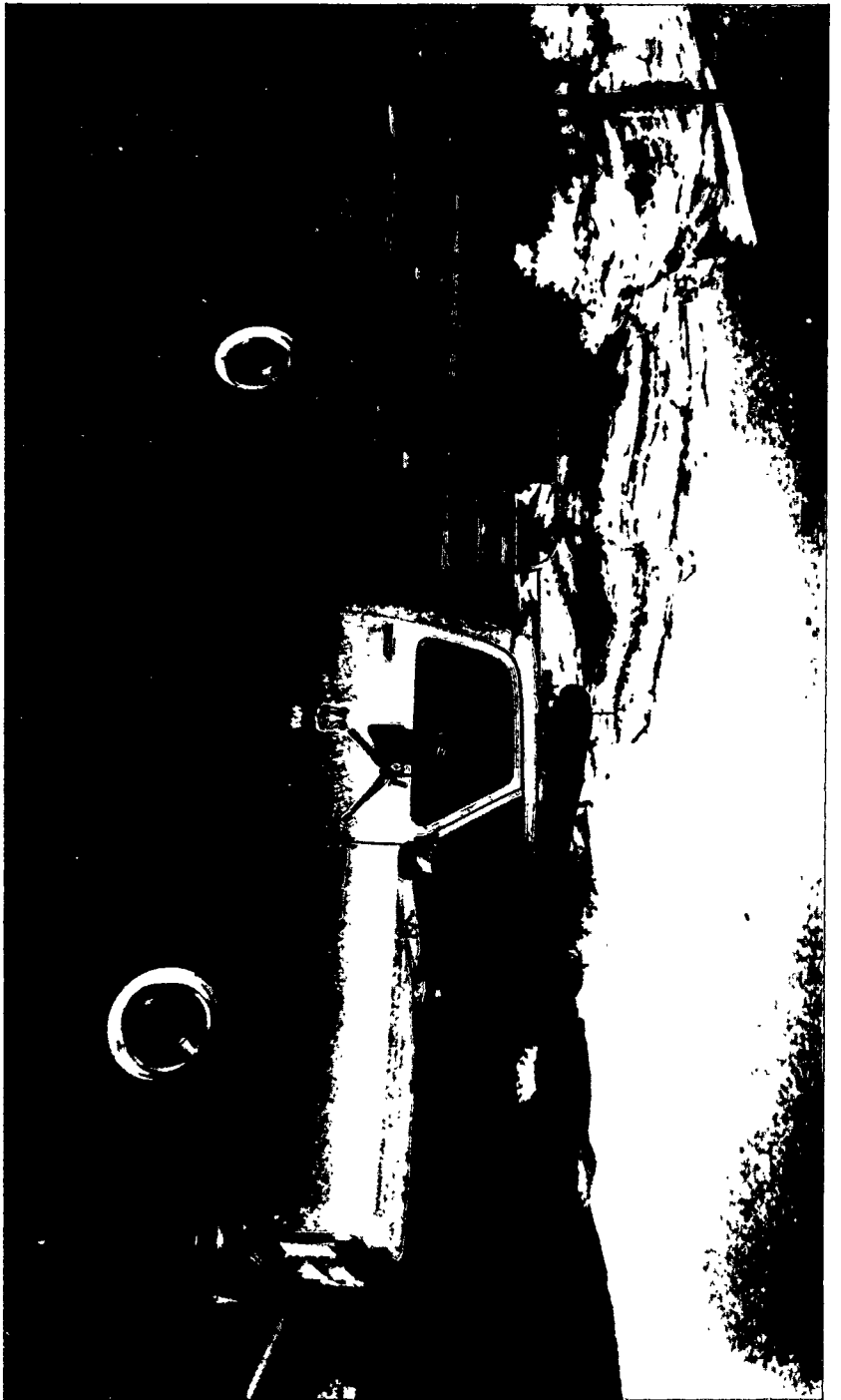
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INTRODUCTION

This Operator Guide provides a ready reference on the following topics for both the vehicles and the pumpers of the Models 10 and 20/21 slip-on units and the Integral Model 41:

- Applicable specifications
- Operating tips
- Field maintenance
- Troubleshooting and problem solving

The Guide is also intended to be a training text for crew members. You will not find all the answers to all your questions in this Guide. A list of references is provided in the final section so you can search for more detailed information that you desire on specific topics. Also do not forget to consult (when available) the manuals, booklets, leaflets, or flyers that come with the various Model 10, 20/21, and 41 components and applicable agency handbooks and manuals. Frequently consult this Guide and the vehicle operator's manual which are to be kept in the vehicle.

Model 10, 20/21, and 41 Engine

Pumpers used to deliver water during wildfire suppression efforts are designed to operate under rough conditions of high stress and vibration on unpaved or mountain roads, or off-highway. They can be categorized according to whether their fire package is removable (slip-on) or fixed (Integral).

Slip-ons consist of a package assembly that contains a water tank, an engine-driven pump, a hose reel or basket(s), plumbing, and hydraulic/electrical controls. These slip-ons can be removed from the rear of a pickup or flatbed truck so that the vehicle can be used on assignments other than fires. Integral equipment are fixed units and have an integral power source that is either a power take-off (pto) or an auxiliary pump engine. The size of the truck used depends upon the amount of water, the equipment complement, and crew size to be transported.

There is no "compartment configuration" for the Model 10. The Models 20/21 and 41 have Pacific Southwest Region (R-5) configuration standards and auxiliary equipment content lists; (see R-5 supplements to FSM 5160).

All Model 10's have a live hose reel for high-pressure booster hose. Models 20/21 and 41 either have the live hose reel or a hose basket designed for 200 ft of 1-in standard fire hose. Basically the difference between a Model 20 and 21 is that the Model 21's water tank is narrower to accommodate the unit's dual rear wheels. A Model 41 is an integral type of pumper unit that carries 125 or 200 gallons of water.

SPECIFICATIONS

Pumper specification sheets for the Models 10, 20/21, and 41 are presented on the pages that follow. Specifications for the various makes and vintages of vehicles should be obtained from your vehicle operators guide, local fleet manager or dealer.

MODEL 10 PUMPER SPECIFICATIONS

Tank

Type: 50-gal, treated steel, baffled internally into two compartments

Overall dimensions: 26-1/2" wide x 43" long x 41" high

Weight: (less water): 390 lb

Pump

Manufacturer: ECO....Model: 251D

Type: Positive displacement....Rated output: 11 gpm @ 150 psi

Engine

Manufacturer: Briggs & Stratton....Model: 80332

Type: Gasoline, single-cylinder, four-stroke, air-cooled

Net horsepower: 3 @ 3,600 rpm....Spark plug: Champion J8

Controls

Inlet: Suction from tank with valve and capped outboard connection.

Outlet: Discharge to live hose reel (250-ft capacity, 3/4" high-pressure hose) with pressure relief valve and return to tank.

MODEL 20/21 PUMPER SPECIFICATIONS

Tanks

Type: 75, 125 or 200 gal, treated steel; baffled internally into various compartments.

Pumps

Early Production

Manufacturer: Hale Fire Pump Co....Model: HPZZ

Type: Single-stage centrifugal....Rated output: 15 gpm @ 200 psi

Static pressure (approx.): 225 psi

Maximum output at free flow (approx.): 65 gpm

Later Production

Manufacturer: Berkeley....Model: B1-1/2XQBS-10

Type: Single stage centrifugal....Rated output: 18 gpm @ 200 psi

Static pressure (approx.): 250 psi

Maximum output at free flow (approx.): 65 gpm

Current Production

Manufacturer: Berkeley....Model: B1-1/2XQBS-11

Type: Single-stage centrifugal....Rated output: 27 gpm @ 200 psi

Static pressure (approx.): 250 psi

Maximum output at free flow (approx.): 65 gpm

Engine

Manufacturer: Briggs & Stratton....Model: 252417

Type: Gasoline, single-cylinder, four-stroke, air-cooled

Net horsepower: 10 @ 3,600 rpm....Spark plug: Champion J8

Controls

Inlet: Suction from tank and 1-1/2" outboard with valve controls

Outlet: Discharge to live hose reel (250-ft capacity, 3/4" high-pressure hose) and 1-1/2" outboard with control valves

MODEL 41 PUMPER SPECIFICATIONS

Tanks

Type: 125, or 200 gal, hot-dip galvanized steel; baffled into various compartments

125 gal overall dimensions: 40-1/2" wide x 36-1/2" long x 22" high..

Weight (less water): 2,290 lb

200 gal overall dimensions: 40-1/2" wide x 57-1/2" long x 22" high

Weight (less water): 2,500 lb

Pump

Manufacturer: Gorman-Rupp....Model: 02F1-GR

Type: Single-stage centrifugal....Rated output: 70 gpm @ 200 psi

Static pressure (approx.): 230 psi

Maximum output at free flow (approx.): 165 gpm

Engine

Pump is driven by a side-mount pto on main vehicle transmission or transfer case.

Controls

Inlet: Suction from tank and outboard with valve controls.

Outlet: Discharge to live hose reel (250-ft capacity, 3/4" high-pressure hose) or 200 ft 1" fire hose and outboard with control valves.

DRIVER QUALIFICATIONS AND RESPONSIBILITIES

All personnel who operate Government owned or leased motor vehicles must meet qualifications stated in FSH 7109.19, Chapter 60.

To avoid accidents, modern-day traffic conditions require that drivers be responsible, mature, and skillful. Operating a vehicle safely includes:

- Personality and attitude of the driver
- Satisfactory completion of driver training and testing program
- Good knowledge of limitations and condition of the vehicle
- Physical features and terrain of the roadway
- Weather and lighting conditions
- Attitude, behavior, and reactions of drivers of nearby vehicles.

Despite all mechanical improvements and automotive safety advances, the driver is still the key to traffic safety. Drivers must keep in good physical condition, have sound driving skills and habits, and develop and maintain proper attitudes. The attributes of a good driver are directly related to attitude, skills, knowledge, judgment, habits, physical and mental fitness.

Attitude

A good attitude is possibly the most important requirement of a good driver. A driver's attitude is reflected in the mental regard for self, for others, for the vehicle, and for surrounding conditions. A driver with a poor attitude usually has an excuse for any adverse occurrence such as, the other person was at fault, the roadway was bad, the intersection was blind, etc.

Attitudes are learned and not inborn. Attitudes can be improved. Unfortunately, the driver who is a nice person until behind the wheel is not rare. There is always the danger that, upon climbing into the "rig" and acquiring the authority of red lights, siren, and several tons of vehicle, the driver feels suddenly like a "big shot," with no need to consider courtesy or safety.

The big-shot attitude is wrong and only leads to trouble. Recent tests indicate that self-styled "experts" usually have an attitude of indifference that tends to cloud judgment and often results in an accident. Be alert. Lack of attention to responsibilities on the part of a driver indicates a need for attitude improvement.

Factors that contribute to a bad driving attitude include:

- "Big headedness" (i.e., over-confidence, pride in past record, and faith in experience)
- False perceptions
- Impatience

Big Headedness: There are drivers who take too much for granted and have serene confidence that the vehicle will perform to their will. They count on other people to do the right thing at all times. Some get puffed up about an accident-free record, forgetting how just a little inattention can make the "clean slate" meaningless.

Believing that having been a driver for a long time will see one through can lead to trouble. A lot of experience,

in and of itself, is not enough. It must be supplemented by continuing comprehensive training and self-analysis of one's attitudes and capabilities.

False Perceptions: Too many of us rely on guesses, estimates, legends, and hearsay—instead of facts—when we are behind the wheel. When 100 drivers were quizzed, 90 of them were short by more than 40 ft when estimating the stopping distance at a given speed. At 20 mph, the average driver will travel 45 ft before braking to a stop; at 30 mph, 78 ft.

Impatience: By taking needless chances, suppressing good judgment, and ignoring safe-driving practices just to save time, one can undo in an instant all that good driver training strives to accomplish.

Skills

Records show that some drivers of exceptional skill are repeatedly involved in accidents, while less adept drivers often have good safety records. So, skill in driving does not necessarily mean safe-driving performance. Skill is ability plus training. Good driving is skill plus a good attitude; poor driving results from a bad attitude—even if coupled with skill. The extent to which skill is applied becomes more important, in the end, than how much skill is developed.

Knowledge

Good knowledge of the total vehicle (chassis-cab plus pumper unit), its capabilities and limitations plus knowledge of response routes, hydrant or water tank locations, and applicable rules and regulations are essential to skillful driving. Drivers not having this knowledge are apt to be distracted and confused to the extent that they become accident-prone.

Habits

Habits are learned and acquired through training and self-discipline. Breaking ingrained habits has long been recognized as more difficult than learning new acceptable ones. This has been observed to be true for most agency operations. Acquiring good habits is of maximum importance in driver training.

Fitness

Physical: Any assigned driver, who is the least bit ill, fatigued, drowsy, or affected by medication should refrain from driving and request a relief driver. Additionally, crew leaders have the responsibility to replace any driver who appears not to be alert and capable of safely operating the vehicle.

Mental: Attitude can change from day-to-day, hour-to-hour, and minute-to-minute. Drivers must concentrate on driving, removing from their mind all distracting thoughts. If a driver does not have a clear mind because of domestic problems, financial difficulties, or on-the-job conflicts with fellow workers and/or supervisor, then driver status should be surrendered or taken away.

Judgment

Performance as a driver hinges on whether or not you possess good sound judgment. You will possess good judgment with a proper attitude, good skills, adequate knowledge, right habits, and suitable fitness.

VEHICLE OPERATION

Preparing to Drive

Prior to operating the vehicle insure that an operator pretrip inspection is completed. Adjust the driver's seat so you can easily operate all controls. Check to see that there is nothing on the cab floor that might roll under the accelerator or brake pedals once the vehicle is underway. Adjust all mirrors for maximum visibility to the rear. Fasten seat belts before starting the vehicle's engine.

The gauges on the dashboard provide information on oil pressure, water temperature and engine rpm—in addition to amount of fuel in fuel tank(s), charging/discharging of battery, elapsed mileage, and speed. Driver should become thoroughly familiar with type and location of all gauges in your chassis-cab. Drivers should also become familiar with the operational "norms" for oil pressure, water temperatures, alternator, air pressure, etc.

In addition to this section of the Guide, be sure to regularly consult the manual that came with the chassis-cab plus the following agency publications:

Starting And Shifting

Be sure the parking brake is set and the transmission is in park/neutral. Turn the ignition switch on. Engage the starter, being sure the clutch pedal (if applicable) is fully depressed. Avoid revving during the first 30 seconds to insure that lubricant is present throughout the engine. If diesel engine, refer to owner's manual for specific starting instructions.

Manual Transmission

Proper shifting is possibly the most important of all driving skills. Correct use of the various gears increases engine performance, provides longer engine and transmission life, and enhances safe driving. The clutch pedal should be fully depressed prior to selecting a gear.

Driving

Start the vehicle in motion by using the lowest transmission gear speed that enables the engine to easily start the load without slipping the clutch. Accelerate smoothly and evenly to engine-rated speed.

When starting on a grade with the clutch engaged, the rpm will drop off significantly. When engine rpm falls off, do not disengage the clutch and try to increase the engine rpm. Doing so may damage the driveline components. After the initial drop in speed, the engine will recover and accelerate in a normal manner.

Avoid lugging the engine. Engine rpm should be maintained in the operating range. This range is from the peak engine torque rpm to the governed engine rpm. Never allow the engine rpm to drop below peak torque rpm when pulling a hill or allow the rpm to exceed the peak engine torque rpm when proceeding down hill on compression. Check the engine specifications for your vehicle's operating range.

Downhill Operation

Prevent over-speeding of the engine when going down steep grades. The governor has no control over engine speed when it is being pushed by the loaded vehicle. Operate in a gear that will permit an engine speed not in excess of peak engine torque rpm. Operating the engine beyond peak engine torque rpm speed can cause severe damage. Select appropriate gear before descending grade. Reduce speed if necessary by liberal use of foot brake.

WARNING: Allowing your vehicle to coast in neutral is illegal. This practice results in severe transmission damage; also, engine braking would not be available.

Steering

Except when shifting gears, keep both hands on the steering wheel, preferably in the ten and two o'clock positions with thumbs up. This helps minimize the possibility of losing control should there be pot holes or ruts in the road. Avoid shifting gears while turning the vehicle.

When backing the vehicle, a spotter will be used to assist in guiding the driver. If a spotter is not available, get out and check behind the vehicle before backing.

Stopping Distance

There are many factors that determine the total stopping distance of the vehicle; the three most significant are:

- Perception/reaction time—Time it takes the driver to see and identify the problem and start braking.
- Brake lag—Time between brake pedal application and the brakes contacting the drum.
- Braking distance—Distance the vehicle travels once the brake is applied.

The effect of vehicle speed on these factors (and, thus, on the total stopping distance) can readily be seen in Table 1. When the speed is doubled, the average perception/reaction and brake lag distances are approximately doubled, while the average effective braking distance is increased four times.

Table 1.—*Vehicle Speed vs. Stopping Distance*

Vehicle speed		Average perception/ reaction distance	+	Average brake lag distance	+	Average effective braking distance	=	Average total stopping distance
mph	fps	ft		ft		ft		ft
30	44	66		18		45		129
60	88	135		35		180		350

Mechanical Parking Brake

The mechanical parking brake is not designed to help bring the vehicle to a stop. Its purpose is to prevent the vehicle from rolling when parked. Chock blocks are required when the vehicle is parked even on a level surface.

Emergency Responses

Forest Service policy requires that employees comply with all state and local regulations. Over 30 sections of the California Vehicle Code (CVC) have material applicable to emergency vehicles. A "Code 2" response means the vehicle proceeds directly without delay to the scene of the emergency. The driver is to obey all traffic laws and rules of the road.

If authorized and equipped, "Code 3" means proceed under red light and siren. During Code 3 operation, section 21055 of the CVC exempts drivers of authorized emergency vehicles from complying with certain provisions of

other sections of the CVC. However, section 21055 does not:

- Relieve the driver of the responsibility of driving with due regard for the safety of all aboard the emergency vehicle and all those within other vehicles, or pedestrians, using the roadways (section 21056).
- Grant any exemptions to an emergency vehicle when the red light and siren are not in use (as when returning to the station after emergency duty, etc.).
- Protect the driver from the consequences of arbitrary exercise of emergency response privileges.

Other points to be kept in mind include:

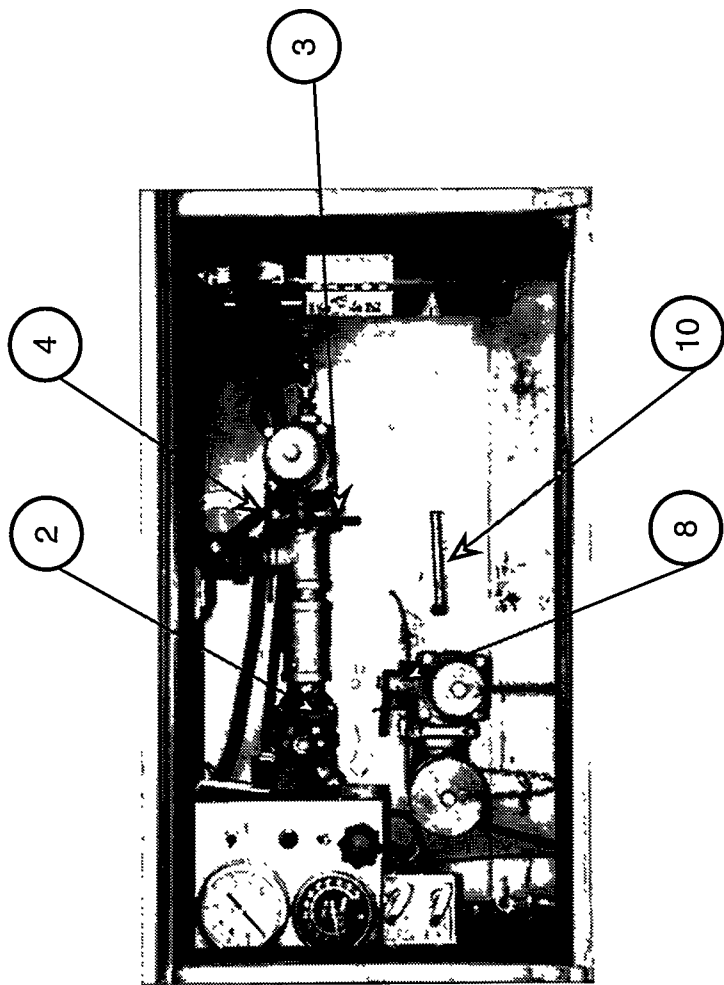
1. Never start out on an emergency response without knowing where you are going.
2. Motorists and pedestrians must be afforded the opportunity to yield the right-of-way to an emergency vehicle, especially at intersections.
3. Never travel through an intersection at a speed greater than one at which the emergency vehicle could be stopped if the vehicle's right-of-way is violated.
4. Be aware that a motorist, upon first hearing a siren, might stop just ahead of the emergency vehicle.
5. Do not pass on the right unless this is your only recourse—and then only with extreme caution.
6. Keep near the center of the roadway so that oncoming traffic can see your approaching red lights.
7. When more than one emergency vehicle is proceeding down the same road, be aware that motorists, having yielded to the first one, may then pull out in front of the remaining emergency response vehicles.

8. If you get caught in an urban, congested bumper-to-bumper situation and know of no feasible alternate routes, suspend Code 3 operation and proceed with the flow of traffic as best you can.
9. When traveling on a freeway, turn off the siren and red lights and proceed with the flow of traffic.
10. Do not continuously sound the siren at its highest pitch—fluctuate it throughout its tonal range.
11. Use the air horn only when approaching intersections and then just two or three short blasts are sufficient.

Table 2. Standard Forest Service valve numbers.

Valve No.	Function
1	Tank to pump
2	Pump to tank
3	Overboard discharge
4	Live reel or hose basket
6	Priming valve
7	Automatic pressure relief
8	Overboard suction
10	In-tank shutoff
11	Pump & plumbing drain
12	Pump cooling-line cleanout
13	Hydrant fill

Callout numbers refer to Table 2 valve numbers on Model 41 Pumper side panel.



Important Pointers

- A. One inch of vacuum will lift water approximately one ft.
- B. The maximum vacuum a pump can create will drop approximately 1 inch for every 1,000 feet gain in elevation.
- C. One psi pressure will raise water approximately 2 ft.
- D. The top of the suction strainer should be at least 6" under water when drafting. If necessary to draft from lesser depths, the pump should be run at a slow speed to avoid producing a whirlpool effect. Do not rest strainer on the streambed. Be sure screen is not clogged. Place a shovel under the screen. If water is too shallow, first dig into streambed.
- E. Draft cleanest water available.
- F. Inspect strainer in suction plumbing after drafting.
- G. Visible ball valves are "open" when handles are parallel with the run of the pipe.
- H. Valves behind panels are "open" when handles are vertical.
- I. Work all valves periodically to insure good operation.
- J. The pump should be operated periodically to insure proper operation.
- K. Keep dry-pump operation to a minimum, never exceeding 30 seconds of unprimed pumping operation.
- L. If pump is run when dry, do not add water until the pump is cool to the touch.

Model 10 Operation

Pump engine

- 1. Check oil level and fuel supply before starting. (Do not check fuel while pumping as vibration can cause gasoline to splatter on hot engine.)
- 2. Change crankcase SAE 30 oil every 25 hrs.
- 3. Service air cleaner at least every 8 hrs.

Pumping

Valves (see table 2) are No. 1, 2, 7, and 8. However, in the Model 10, No. 8 is capped (no valve present) and the cap serves as the valve.

Pumping from Tank to Hoseline

1. Turn ignition switch to manual OVERRIDE position.
2. Open valve No. 1 and No. 2. Insure No. 8 is capped. (Opening No. 2 relieves back pressure and eases starting)
3. Start pump.
4. Close valve No. 2 and return switch to AUTOMATIC SHUTDOWN.

CAUTION: Do not exceed 30 seconds dry-running time.

Pumping from a Stream to Discharge Line or Tank

1. Turn ignition switch to manual OVERRIDE position.
2. Attach a short section of 3/4-in ID high-pressure hose with foot valve and strainer to No. 8 inlet.
3. To prime pump, fill suction hose with water (from canteen or helmet) before attaching hose to No. 8 inlet.
4. Close valve No. 1.
5. Start pump.
6. Open valve No. 2 to fill the tank.

Preparation for Winter Storage The following is a post-fire season checklist:

1. Drain pump engine gas tank; run engine until gas in carburetor and lines is used up. Remove the spark plug and add 1 tbsp oil to the cylinder.
2. Open No. 8 inlet and both valves to drain plumbing. To drain water from the pump, slowly pull the starting rope one time.
3. To drain the tank, remove the 1-in plug at the bottom of the tank.
4. Drain and store hoses.
5. Mark unit with date and "prepared for winter storage."

Models 20/21 Operation

Pump Engine

1. Check oil level and fuel supply before starting and periodically during operation.
2. Change crankcase SAE 30 oil every 25 hrs.
3. Service air cleaner at least every 8 hrs.
4. After the engine has operated under load, allow the engine to cool down by idling up to 2 min before turning engine off.

Pumping

Valves (see table 2) are Nos. 1, 2, 3, 4, 6, 8, and 10.

Pumping from Tank to Hose line

1. Open valves No. 1 and/or 10; close all other valves.
2. To prime pump open valve No. 6, activate hand primer with the engine running at idle. Close valve No. 6.
3. Adjust the throttle for desired pressure.
4. Open desired discharge line, valve No. 3 or No. 4.

Pumping from a Stream to Discharge Line

1. Attach suction hose to valve No. 8 and place strainer on end of hose.
2. Open valve No. 8; close all other valves.
3. Perform the priming operation as in B above "Pumping from Tank to Hose line."
4. Adjust the throttle for desired pressure.
5. Open desired discharge line, valve No. 3 or No. 4.

Pumping from a Stream to Tank

1. Attach suction hose to valve No. 8 and place strainer on end of hose.
2. Open valve No. 8; close all other valves.

3. Perform the priming operation as in B above "Pumping from Tank to Hoseline."
4. Open valve No. 2.
5. Adjust throttle for desired pressure.

Pump Caution:

1. Keep running time of dry pump to a minimum.
2. Do NOT operate pump for long periods of time at high pressure and no flow. Instead, open nozzle or No. 3 valve from time to time to allow some water to flow through the pump.

Preparation for Winter Storage. The following is a post-fire season checklist:

1. Drain pump engine gas tank; run engine until gas in carburetor and lines is used up. Remove the spark plug and add 1 tbsp oil to the cylinder.
2. Open all valves and remove all caps.
3. To drain the tank, remove the 1-inch plug at the bottom of the tank and also the plug in the pump-valve case.
4. Service the pump engine, drain and refill the crankcase, service the air cleaner.
5. Drain and store hoses.
6. Mark unit with date and "prepared for winter storage."

MODEL 41 Operation

Pump Engine

1. To start the engine, the AUTOMATIC SHUTDOWN switch on the control panel must be in the OVERRIDE position.
2. With the engine running and transmission in neutral, engage pto to pump by depressing the clutch pedal and pull the pto handle out. Release the clutch pedal slowly.
3. Do NOT exceed 2,200 engine rpm while pumping.
4. Four wheel drive vehicles with pumps driven by the transfer case require that the transmission be in 4th gear and that the transfer case be in neutral before engaging the pto.

Pumping

Valves (see table 2) are Nos. 1 (when so equipped), 2, 3, 4, 8, 10, 11, and 12. See table 3 for a summary of Model 41 pumper operating instructions.

Pumping from Tank to Discharge

1. Depress the clutch pedal, place transmission in neutral, and engage the pto.
2. Increase the throttle to approximately 1,000 rpm.
3. Close valve No. 2 and open valve(s) No. 1 and/or 10 and discharge lines, either valve No. 3 or 4.
4. Place switch in AUTOMATIC SHUTDOWN position.
5. Adjust the throttle for desired pressure.

Pumping from Outside Water Supply to Discharge

1. Remove the cap on valve No. 8 and attach a suction hose and strainer; place the strainer end of the hose into the water source at least 1 ft below the water surface.
2. Open valve No. 8 and close valves No. 2, 3, 4, 1 and/or 10.
3. The pump is self priming; however, if the tank is empty, obtain a prime by removing the cap above the pump and filling pump with water.
4. Depress the clutch pedal, place transmission in neutral, and engage the pto.
5. Increase the throttle to approximately 1,000 rpm.
6. Place switch in AUTOMATIC SHUTDOWN position.
7. Open desired discharge line, valve No. 3 or No. 4.
8. To fill the tank, partially open valve No. 2; close this valve when tank is full.

Pumping from Outside Water Supply to Tank

1. Close valves No. 1 and/or 10, 3, and 4; open valve No. 2.
2. Attach a suction hose and strainer to valve No. 8; open valve No. 8.
3. Depress the clutch, place transmission in neutral, and engage the pto.
4. Run engine at 1,000 rpm until pump is primed.

Running Attack

1. Set valves to pump from the tank to either hose reel or basket.
2. Depress the clutch pedal and engage the pto with the transmission in the lowest gear; release the clutch pedal and move forward.

NOTE: Pressure develops only when the vehicle is moving. Do NOT exceed 2000 engine rpm while pumping.

Table 3.—Model 41 Pumper Operating Instructions.

Operation	1	2	3	4	8	10
Tank to fire	O	X	O	O	X	O
Suction to fire	X	X	O	O	O	X
Suction to tank	X	O	X	X	O	X
Drain plumbing	O	O	O	O	O	X
Drain tank	O	O	O	O	O	O

KEY: O = Open; X = Closed.

NOTE: To prime the pump when the tank is empty, remove the cap over the strainer and fill pump with water through the strainer.

Pump Maintenance:

1. Check the oil level in the pump gearbox regularly by removing the oil level plug on the front of the case; it is approximately 1 1/2" from the bottom of the case. The oil should be level with the plug; if low, add SAE 90 gear oil—do NOT overfill. Also, under normal operating conditions, drain and refill the oil in the pump gearbox annually.

2. To test the pump, attach a 3/8" nozzle tip to the 1-1/2" overboard (No. 3) discharge line. Operate the engine at 2,200 rpm.
3. If pressure is not at least 200 psi, request necessary adjustments or repairs through mechanic.

Preparation for Winter Storage. The following is a post-fire season checklist:

1. Open all valves and drain cocks and remove all caps. Drain and store hoses.
2. To drain the tank, remove the 1 1/2" plug at lower back center of tank.
3. Open pressure gauge drain cock that is just below the pressure gauge.
4. Mark unit with date and "prepared for winter storage."

FIELD MAINTENANCE

Preventive Maintenance: The vehicle operator and crew leader are responsible for the performance of minor maintenance, lubrication, and servicing of assigned vehicles and equipment at proper time or mileage intervals. Minor maintenance includes making simple adjustments to compensate for wear, tightening or replacing loose bolts or nuts, and all similar tasks for which the operator is qualified and equipped.

Consult FSH 7109.19, Fleet Equipment Management Handbook, for preventive maintenance checks for firefighting equipment. These shall be made at least once a month or after use on a fire, whichever occurs first. The following forms, as applicable, shall be completed while making preventive maintenance checks:

Form 7100-9—Driver's Safety and Preventive Maintenance Check for Transportation Equipment.

Form 7100-9e—Safety and Preventive Maintenance Inspection Check Sheet, Fire Pumper.

Forward the original of the form(s) through proper channels to unit headquarters and place a copy in the equipment log book; remove the preceding copy. Record engine lubrications, oil and filter changes, and preventive maintenance checks on the log book's unit service record. Then post the next services due on the service reminder sticker.

Preventive maintenance tasks to be performed on a regular basis:

Check

- Gear-train boxes for oil level
- Engine drive belts for tightness
- Air cleaner indicator gauge
- Nuts and bolts for tightness
- Tires for proper pressure when cold
- Brakes for proper operation
- Hydraulic brake system for leaks
- All lights, and siren if equipped
- Clutch pedal in manual transmission vehicles for excess play.
- Engine oil & coolant level

Inspect

- Batteries for water, bracket tightness, and terminal connection condition and tightness.
- Tires for wear, damage, rocks, nails, and other foreign objects.
- Wheel lug nuts for tightness
- All instruments, gauges, and accessories for proper operation.

Towing

Vehicles must be towed with the rear wheels off the ground or with the drive shaft disconnected at the axle to prevent damage to the transmission.

Tire Inflation

Incorrect tire inflation pressures can have adverse effects on tire life and vehicle performance. Too low an air pressure causes increased tire flexing and heat build up. This weakens the tire and increases the chance of damage or failure and can result in tire overloading, abnormal tire wear, adverse vehicle handling, and reduced fuel economy. Too high an air pressure can result in abnormal wear, harsh ride, and increased chance of damage from road hazards. Check tire inflation pressures at least weekly, including the spare tire. Always check these pressures when the tires are cold. Correct maximum cold inflation pressures are indicated on tire sidewalls.

Torquing Wheel Lug Nuts

For both single and dual wheels, wheel lug nuts should be tightened alternately and evenly to the correct torque. Refer to manufacturer's specifications. Never use oil or grease on wheel studs or nuts.

Catalytic Converters

The catalytic converter (on vehicles so equipped) is an emission-control device added to the exhaust system to reduce exhaust gas pollutants. The converters contain a ceramic material coated with noble-metal catalysts. Use only unleaded gasoline in these vehicles to prevent contamination of the catalysts. Use of leaded gasoline is unlawful. Leaded fuel causes the converters to lose their emission-control effectiveness.

CAUTION: Catalytic converters generate extreme temperatures. Be aware of this when off roads in flashy fuels.

Hydraulic Brakes

Maintenance: Check master brake cylinder for fluid level; if brake fluid is needed, add only type recommended in vehicle operator's manual. Also check brake lines, hoses, and the rear of the wheel backing plates for any indication of leaks or deterioration.

Test-Pump the brakes twice, hold applied brakes for 10 seconds to check for brake pedal travel. Notify a mechanic if the travel exceeds 2 inches.

Power Steering

Maintain the power steering fluid level as noted in the vehicle operator's manual using only the type fluid listed in the manual. Do not overfill. Also check the tightness of the power steering drive belt. Replace the belt if it is deteriorated.

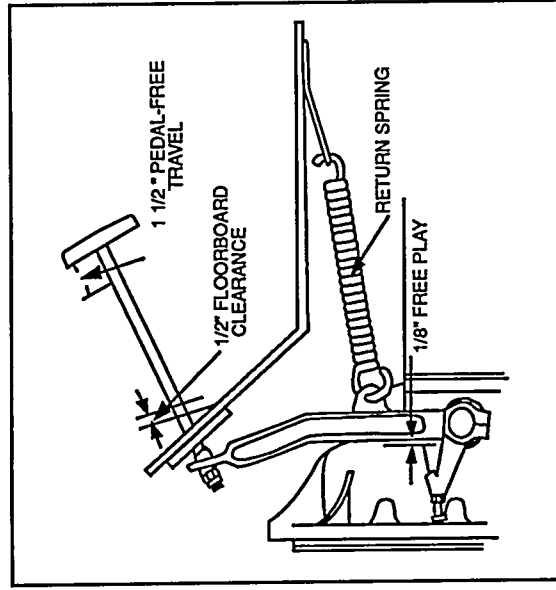


Figure 1.—Clutch Adjustment.

Clutch Adjustment

Figure 1 shows typical clutch control linkage. If there is no pedal-free travel or excessive pedal-free travel, contact a mechanic for adjustment.

Cooling System

When the vehicle engine is cold, check the level of the fluid in the radiator and also that in the surge tank, if any. There should be fluid to approximately 1" below the radiator neck and to the level marked on the surge tank; if not, add fluid as required.

CAUTION: Do not remove the radiator cap when vehicle engine is hot.

Use only ethylene glycol antifreeze in the cooling system; protect to -25°F. Check entire cooling system (radiator and hoses) for leaks or cracks; remove bugs and foreign material from the front of the radiator. Check the fan belt for approximately 3/4" deflection between pulleys. Replace the belt if it is deteriorated.

Electrical System

Adjust the alternator drive belt for approximately 3/4" deflection between pulleys. See that all electrical wiring is protected from moving parts and engine heat.

CAUTION: Overtightening the fan belt or the alternator drive belt can cause premature failure of the water pump and the alternator bearings.

Pump

Check the pump speed increaser oil level. This should be maintained to the bottom of the fill plug hole. If the oil appears milky, it has probably been contaminated by water; notify a mechanic. Also, drain the sediment trap in the overboard suction line (valve No. 8) every week, and after each drafting use.

Equipment Lists

Following the Troubleshooting and Problem Solving charts is a list of equipment applicable to Model 41 Pumps.

TROUBLESHOOTING AND PROBLEM SOLVING

The charts presented here indicate the steps to be taken by individuals when certain problems crop up with a Model 10, 20/21, or 41 system or component. However, if individuals do not have proper tools and pertinent training, or if a problem is not listed on one of these charts with a suggested remedy, contact the unit fleet manager.

NOTE: These items (*) are shown for diagnostic purposes only. Repairs should be done by trained mechanics in the shop.

Chart 1.—Vehicle Wheel Problems

Problem	Possible Cause	Remedy
Frozen lug nuts.	Corrosion or galling.	If corrosion is slight, wire brush. If excessive, replace studs and nuts.* If condition persists, lubricate first three threads of each stud with a graphite-based lubricant—do not get lubricant on ball seats of stud holes or on ball face of lug nuts.
Loose inner wheel.	Loose inner nuts. Too much stud stand-out from mounting face of hub permitting wheel nut to loosen.	Replace with stud of correct length. Tighten inner nut, following correct torque procedure.*
Damaged inner or outer lug nut.	Loose wheel assembly.	Replace lug nuts; check for proper stud stand-out.*
Broken or stripped studs.	Loose lug nuts, overloading or incorrect wheel.	Replace with studs of correct length.
Mutilated stud thread.	Loose lug nuts, overloading or incorrect wheel.	Replace with studs of correct length, and/or wheel.*
Wheel cracks from stud hole to stud hole.	Loose lug nuts, overloading, or incorrect wheel.	Check for worn mounting face, loose studs in hub, worn stud grooves, or cracked or broken studs. Replace wheel and other damaged parts.*

Problem	Possible Cause	Remedy
Rust streaks from stud hole.	Loose lug nuts.	Check complete assembly and replace damaged parts. Follow proper installation procedure.
Metal build-up around stud hole; out-of-round stud hole.	Loose lug nuts.	Replace wheel, following proper installation procedure.
Excessive vibration.	Bent and/or loose wheel. Foreign object wedged between duals.	Replace wheel, following proper installation procedure. Remove foreign object.

*These items are shown for diagnostic purposes only. Repairs should be done by trained mechanics in the shop.

Chart 2.—Vehicle Won't Move With Standard Transmission In Gear

Problem	Possible Cause	Remedy
Vehicle will not move when transmission engaged.	On 4 x 4's, transfer case or auxiliary transmission is not in gear.	Check to be sure transfer case or auxiliary transmission is in gear.
Clutch pedal stays in down position or otherwise doesn't operate.	Clutch linkage pin broken or missing or return spring broken. Complete clutch failure.	Replace linkage pin or return spring. Contact unit fleet manager.

Chart 2A.—Vehicle Won't Move With Automatic Transmission In Gear

Problem	Possible Cause	Remedy
Vehicle will not move when transmission engaged.	On 4x4's, transfer case or auxiliary transmission is not in gear. Needs transmission fluid as indicated on dipstick. Shift linkage pin broken or missing.	Check to be sure transfer case or auxiliary transmission is in gear. Check fluid level with transmission at operating temperature, gear selector in "neutral," and vehicle on level ground. If fluid must be added when transmission is cold, do not fill above the "add" mark on the dipstick. Always check fluid with engine running and gear selector in neutral position. Replace linkage pin.

Chart 3.—Cooling System Problem

Problem	Possible Cause	Remedy
Vehicle engine overheating.	Worn, loose or broken belts.	Check fan and alternator drive belts; replace if defective or adjust if necessary.
	Insufficient coolant.	Check coolant level, condition, and strength of the antifreeze solution. Most systems require protection to -25°F to insure protection against corrosion and boiling.
	Deteriorated radiator cap.	Check radiator cap for proper function and fit. This should only be done when the engine is cool.
WARNING: Do not remove radiator cap when engine is hot.		
	Faulty warning light or temperature gauge.	Check wiring to the temperature gauge or light.
	Coolant leaks.	Repair radiator.* Repair or replace hose.
	Engine overloaded or lugging.	Use low gear on grades; turn off air conditioner.

*These items are shown for diagnostic purposes only. Repairs should be done by trained mechanics in the shop.

Chart 4.—Hydraulic Brakes Malfunction

Problem	Possible Cause	Remedy
Brake pedal feels spongy or goes all the way to the floor.	Not enough brake fluid.	Park vehicle safely. Check for leak. If no leak, add brake fluid. (Check all hydraulic lines to try and spot a leak. If a wheel cylinder is leaking, one should find fluid on the brake backing plate or possible dripping out between the backing plate and the brake drum near the bottom. If a leak is found, check to see if it has the distinctive smell of brake fluid. If the master cylinder itself is bad, it may leak fluid onto the cab floor, where the brake pedal actuating rod goes through the fire wall. If no visible leaks can be found yet, brake fluid is definitely disappearing, suspect the vacuum assist unit to be malfunctioning. Sometimes fluid can be seen leaking from the clamp area on the large vacuum canister). If there is a leak, contact unit fleet manager.
	Air in the system.	Notify unit fleet manager for brake repair.

Problem	Possible Cause	Remedy
Brake pedal requires extreme foot pressure to stop the vehicle.	Not enough vacuum.	Check vacuum lines running from the assist unit to the intake manifold on the engine for loose connections, cracks, or breaks, and take appropriate corrective action. Follow up with unit fleet manager.
	Oil on brake linings.	Check wheels and brake drum area for excessive oil. Contact unit fleet manager for repair.
	Brakes may be overheated.	Pull off road, chock wheels, release brakes. Do not proceed until brakes have had chance to cool. Use lower gear descending hills.
	Hydro boost not working.	Check power steering fluid and power steering pump belt.

Chart 5.—Vehicle Engine Starting/Electrical

Problem	Possible Cause	Remedy
Turn ignition key on-nothing happens or one hears a clicking noise.	Weak battery, dirty and/or loose battery terminals or loose electrical connection in starting or charging circuit.	1. Check the condition of the battery terminals. If there is corrosion, disconnect the terminal and clean with a baking soda and water solution. Clean corroded material from conducting surfaces with a wire brush. Re-connect the terminals snugly. Coat the terminals with petroleum jelly to prevent further corrosion. Even if no cleaning is required, carefully tighten the terminals. 2. Have battery(s) tested. 3. Check condition of wiring between battery starter motor and ground wire. 4. Check the condition and tension of the drive belt. Replace the belt if it is frayed or cracked. Tighten belt if there is play or inadequate tension. (The belt should be tightened so that it can be depressed approximately 3/4" between pulleys). Not available if equipped with self-tensioning device.

Problem	Possible Cause	Remedy
	Alternator not charging electrical system.	Check alternator mounts for cracks or loose mounting bolts; tighten bolts if necessary. If battery and charging system appear alright, problem may be faulty starter motor, or solenoid. Contact unit fleet manager for repair.
Dead battery.		Refer to vehicle operator manual for jump start procedure. Jump start could de-program mobile radio.

CAUTION: Never smoke or expose batteries to sparks or flames when inspecting or servicing. Hydrogen gas from cells, escaping through vent holes, could ignite and cause an explosion of the batteries.

Automatic or Standard Transmission: Turn ignition key and nothing happens or one hears a clicking noise.	Gear selector not in "P"ark or "N"eutral. Clutch pedal not fully depressed or faulty safety switch on clutch pedal.	Place gear selector into "P" or "N". 1. Depress clutch pedal fully. 2. Check for frayed or broken wires to clutch pedal safety switch.
Turn ignition key, starter cranks—engine does not start.	Faulty ignition system.	Remove spark plug wire and check for spark—if no spark, check connection on "+" side of coil; if spark is present, check out fuel system (Chart 5A).

Problem	Possible Cause	Remedy
<u>Model 41</u> Turn ignition key—starter cranks—engine does not start.	Pump override is not engaged, engine will start in override only.	Reposition switch to start in the override position.

Chart 5A.—Vehicle Engine Starting/Fuel

Problem	Possible Cause	Remedy
Vehicle quit running, appears to have run out of fuel.	No gas getting to engine or too much gas (FLOODED).	Switch fuel tank. If problem persists, then turn off ignition, remove air filter and check choke butterfly valve. If open, look down carburetor—lack of gas indicates fuel pump system problem, fuel filter problem, or clogged fuel lines. If closed, engine is flooded—wait 10 minutes and try again with accelerator fully depressed—do NOT pump the pedal.

Chart 6.—Troubleshooting Pump

Problem	Possible Cause	Remedy
Model 10/20/21 Pump won't run, ignition is on, kill switch is engaged in override position.	Faulty magneto.	Remove spark plug wire and check for spark. If no spark replace magneto.
Ignition is on, but pump engine will not start.	Petcock on fuel tank is closed. Dirty fuel filter sediment bowl. No gas getting to engine or too much gas (FLOODED).	Open petcock. Remove and clean sediment bowl. 1. If no gas is getting to carburetor, check for fuel in tank or clogged fuel line. 2. If carburetor is flooded, check choke position; if necessary, wait a moment and repeat starting procedure.
Model 10/20/21/41 With pump primed, engine dies as soon as valve number 2 and/or 3 is opened.	Automatic shut down is activated when valves are opened too rapidly, allowing working pressure to drop below 50 psi.	Open valve slow enough to maintain greater than 50 psi. Leave automatic shutdown switch in override until first 300 feet of hose have been pressurized.

Problem	Possible Cause	Remedy
Pump fails to prime when drafting.	Air leak in suction line. Lining of suction hose collapsed. Leaking or worn seal or pump gasket. Excessive pump speed.	Correct leak. Replace suction hose. Check pump vacuum. Replace gasket. Decrease pump speed. Contact unit fleet manager for repair.
Pump fails to deliver rated flow or pressure.	Strainer clogged. Discharge flow too slow. Impeller or other wearing parts worn or damaged.	Check strainer and clean if necessary. Open discharge valve fully to increase flow rate. Contact unit fleet manager for repair.
Excessive noise.	Cavitation in pump. Pump or drive not securely mounted. Impeller clogged or damaged. Bent/misaligned driveshaft/worn universal joints on pump drive.	Identify cause for cavitation and correct. Secure mounting hardware. Contact unit fleet manager for repair. Contact unit fleet manager for repair.

Problem	Possible Cause	Remedy
With pump primed, engine dies as soon as valve No. 2 or 3 is opened.	Automatic shutdown is being activated when valves are opened too rapidly, allowing working pressure to drop below 50 psi.	Open valve slow enough to maintain greater than 50 psi. Leave automatic shutdown switch in override until first 300 feet of hose have been pressurized.
<u>Model 20/21</u> Pump won't prime when drafting.	Exhaust primer does not seal.	Adjust or pad exhaust primer cap for complete seal.
	Clogged vacuum line.	Remove vacuum line running from pump to primer; remove any obstructions; clean venturi (exhaust primer); replace and tighten fittings.
Priming pump handle offers no resistance.	Broken diaphragm or check valve.	Repair/replace broken parts.
Priming pump handle offers considerable resistance.	1. Corroded check valve. 2. Valve No. 6 closed. 3. Valve(s) No. 1 and/or No. 10 are closed.	1. Tap valve to break up corrosion. 2. Open valve No. 6. 3. Open valve(s) No. 1 and/or No. 10.

Model 41 Fire Hose And Fittings

NFES Cat. #	Description	National Stock # (NSN)	Quantity Min.
0046	CLAMP, Shutoff, Pocket Size, for 1" and 1-1/2" Hose	4210-00-767-7123	2
0710	COUPLING, (Double Female), Hose, Rocker Lug, 1" NPSH thread	4210-01-080-1457	1
0916	COUPLING, (Double Male), Hose, Rocker Lug, 1" NPSH thread	4210-01-080-1458	1
2221	GASKET, (Washer) for Hose Coupling Swivel Assorted Set	None	1
	HOSE, 1" ID x 100'; Rocker Lug Couplings with 1" NPSH thread		2
	HOSE, 1-1/2" NH thread		3
0115	HOSE, Suction, 1-1/2" ID x 8'; Rocker Lug Couplings with 1-1/2" NH thread	4210-00-889-1775	2
2235	INCREASER, 3/4" Female NS thread to 1" Male NPSH thread	None	0
0416	INCREASER, 1" Female NPSH thread to 1-1/2 Male NH thread	4210-01-080-6532	1
0024	NOZZLE, Firehose, Combination; 1" NPSH thread	4241-00-640-1892	1
0733	REDUCER, (Adapter) Rocker Lug, 1" Female NPSH to 3/4 Male N	4210-01-070-9286	1
			39

NFES
Cat. #

Description

National Stock # (NSN)

Quantity
Min.

0010	REDUCER, (Adapter) Rocker Lug, 1-1/2" Female NH thread to 1" Male NPSH thread	4210-00-975-2969	2
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	STRAINER, Suction, Firehose, or foot valve		1
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0346	WRENCH, Hydrant, Adjustable	None	1
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0234	WRENCH, Spanner, 1" and 1-1/2" Combination	5120-00-596-1425	1
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0231	WYE, Two-way, Gated, 1-1/2" NH thread	4210-00-984-3475	1
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Model 41 Miscellaneous Tools And Equipment

6295	BAR, Wrecking (3/4" dia. x 36")	5120-00-242-0762	1
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	BLOODBORNE PATHOGEN KIT		1
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3287	BOX, Tool, Steel (21 x 8-1/2" x 7-3/8")		1
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1113	CUTTER, Bolt (3/8" x 24")	5110-00-596-9156	1
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2143	EXTINGUISHER, Fire, Dry Chem, 51b minimum	None	1
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NFES Cat. #	Description	National Stock # (NSN)	Quantity Min.
0475	GOGGLES, Safety	4240-01-292-2816	2
0068	KIT, First Aid (10-Unit #2)	6545-00-656-1093	1
0744	KNAPSACK,	8465-00-205-3493	1
0127	LANTERN, Electric	6230-00-500-0523	0
3264	MEALS, Ready to eat	8970-00-149-1094	4
0296	McLEOD, Tool	4210-00-203-3512	1
0141	PAIL, Canvas	8465-00-582-1277	1
0146	PULASKI, Tool	5120-00-293-3467	1
	REFLECTOR, WARNING	None	3
1047	ROPE, Nylon, 1/2" (100')	None	0
0168	SHELTER, Fire (with case)	4240-01-121-8698	2
0171	SHOVEL, Hand forest fire fighting size #1	5120-00-965-0609	1
			41

Box, Tool - Contents

1059	File, Flat, Mill (Regular, Smooth Cut)	5110-00-203-4645	1
2345	Hammer, Ball Peen 16 oz.	5120-00-242-3913	1
0321	Hammer, Straight Claw, Carpenter's (20 oz.)	5120-00-224-4142	1
0063	Handle, File (Wood, large)	5110-00-263-0341	1
0325	Pliers, Side-cut, Insulated Lineman's (8")	5120-00-756-1156	1
2358	Pliers, Slip-joint, 10"	5120-00-537-3375	1
3289	Screwdriver, Combination (1/4" Flat Tip x # 2 cross tip)	5120-00-301-1076	1
0620	Wrench, Adjustable (8" x 1")	5120-00-264-3795	1
0324	Wrench, Adjustable (12" x 1-5/16")	5120-00-264-3796	1
0641	Wrench, Pipe, Adjustable (2" x 18")	5120-00-277-1479	2