

275

Community Forest Fire Fighting Equipment

*Prepared by N.F.P.A. Forest
Committee; Adopted by National
Fire Protection Association*

1934

Price Ten Cents

National Fire Protection Association
International

**60 BATTERYMARCH STREET
BOSTON, MASS., U. S. A.**

National Fire Protection Association

INTERNATIONAL

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With the cooperation of the U. S. Forest Service and the other organizations represented above, the Forest Committee of the National Fire Protection Association is working out practical means for the prevention and control of forest fires. This report on the subject of community forest fire fighting is believed to be the first attempt to develop a standard of recognized good practice for the guidance of communities confronted with the forest fire problem, particularly those whose experience may not have been sufficiently extensive to give a basis for independent conclusions as to the most effective types of equipment.

The present report, drafted by Mr. C. R. Tillotson, District Forest Inspector, Northeastern States District, U. S. Forest Service, is largely based upon conditions in the Northeastern States, but it is anticipated that this report will be found generally applicable for all regions where similar conditions are found.

This report was first printed in preliminary form in 1932. After extensive circulation, consideration of all suggestions received, and discussion at three annual meetings of the National Fire Protection Association, it was officially adopted in 1934.

COMMUNITY FOREST FIRE FIGHTING EQUIPMENT.

As the title implies, this report is designed to apply in regions where settled areas, either permanent or summer communities, are found in or adjoining wooded territory, as in many portions of New York and New England. Remote and sparsely settled forest regions, particularly in mountainous territory where roads and sources of water are limited or altogether lacking, present entirely different conditions which this report is not intended to cover, though some of its suggestions may be found applicable.

For information on the most recent developments in forest fire fighting equipment and for advice as to the type best suited to meet local conditions, it is suggested that prospective purchasers consult the State Forester in the state where the equipment is to be used.

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THE FOREST AND BRUSH FIRE PROBLEM.

The suppression of forest and brush fires is, and has long been, a civic responsibility. Not only is the destruction of merchantable timber and the consequent financial loss of serious moment, but the intangible loss from such fires is an equally vital matter. Soil is sometimes destroyed and its complete restoration takes hundreds of years. Erosion is more pronounced and rain water runs off rather than soaking into the ground. Birds and animals are killed and streams are rendered unfit for trout and other fish. The attractiveness of the region to summer visitors is reduced. These things affect the welfare, happiness and income of the community, but in spite of this, extremely expensive, blundering and archaic methods of controlling forest and brush fires persist in many communities.

To reduce these tremendous losses and quickly suppress these fires, the prime requisites are:

1. A well organized and trained crew under each forest warden, deputy warden, or fire chief charged with suppressing such fires.

2. Prompt response to fire alarms. Because the forests of the region covered by this report are widely distributed and intermingled with farm buildings, summer homes, and camps, and are of tremendous importance in protecting the sources of drinking water, forest, brush, and grass fires need to be handled just as expeditiously as fires occurring within municipal limits. Prompt and decisive action for their suppression is essential and cannot be urged too strongly. One gallon of water or one shovelful of sand at the start is worth a thousand later on. If attacked vigorously in their incipient stages, forest and brush fires may be easy to control. If not attacked vigorously immediately after receipt of the alarm, they may reach large proportions and become impossible to control without exhaustive labor of many men for days and nights. This means heavy expense to the community, distressing losses to property owners, and an increase in taxes.

3. Use of the best types of equipment. A lack of adequate and proper equipment is often responsible for disastrous forest fires and high suppression costs. A small group of men provided with adequate, up-to-date equipment and trained in its use can often accomplish more than a much larger number inadequately equipped and poorly trained.

It is the purpose of this report to discuss such equipment in the belief that it will assist communities to choose that best suited to their local conditions. There is no pretense that this discussion is the last word on the subject. Better equipment may even now be in the process of design or manufacture. Some equipment may surpass the specifications set up here. Some may not meet these specifications in all respects but still be so good that it will be no mistake to purchase it. Any forest fire equipment put out by a reputable manufacturer who guarantees a satisfactory standard of performance is far better than no equipment at all.

EQUIPMENT.

During the last few years water pumps have come into extensive use. When and where they can be used, pumps are now generally recognized as the most practical and effective type of equipment for fighting forest, brush and grass fires. There are three types of pumps in general use, the small hand pump, the portable power pump driven by a small gasoline engine, and the power pump mounted on an automobile chassis.

In considering such pumps, the principal qualifications are simplicity, dependability, cost, pressure developed, and volume of water thrown. In districts where portable power pumps may have to be carried by men long distances or over uneven ground, weight is an important factor.

SECTION 1. HAND PUMPS.

General.

101. Generally speaking, hand pumps can be used effectively and are recommended for all parts of the regions covered by this report. If promptly and properly used a large proportion of the forest, brush and grass fires can be brought under control without the use of the larger equipment. Moreover, hand pumps may be secured at a reasonable cost. They should be given first consideration by any community intent upon supplying itself with effective forest fire fighting equipment.

102. There are several types of hand pumps on the market. Experience indicates that the 5-gallon knapsack type which is carried on a man's back is the most effective. Such equipment should be of sturdy construction because it will be subjected to considerable abuse.

103. Each organized crew of 10 or 12 men should have at least four hand pumps. During the forest fire season, these pumps should be kept filled with water and set in a place where the water will not freeze. A light truck should be immediately available for transporting them full of water to a fire. For supplying water to these pumps after they have been emptied on a fire, each crew should have at least eight 12- or 14-quart pails, one-handle milk cans, or 5-gallon knapsack tanks. Milk cans are better than pails.

Pump.

111. The pump shall be carefully built and fitted, and of materials that will resist local conditions of corrosion. Bronze, brass, aluminum, or equivalent are preferred. It must be easily dismantled. Packing must prevent leakage and be adjustable without tools. The hose end of the pump should be fitted for $\frac{1}{2}$ -in. hose.

112. All valves shall be of materials that will resist local conditions of corrosion. Valve at end of hose shall have retaining means that will prevent its loss when pump is dismantled in field.

113. The pump should be capable of throwing a solid stream 40 feet or more. A range of less than 25 feet is not acceptable.

114. The pump should preferably be equipped with a nozzle capable of discharging either a solid stream or a broad spray. A combination of nozzles may be used but is less desirable.

115. Hose for hand pumps should be $\frac{1}{2}$ -inch in diameter, kink-proof and preferably equipped with wire insert so as to avoid breakage at connections.

Tank.

121. The tank shall be of materials that will resist local conditions of corrosion. If of metal construction all joints shall be tight and should be locked and soldered, or welded. Metal tanks should have an easily cleaned and snug fitting brass strainer, and a snug fitting round or oval cover six inches or more in diameter in its long axis.

The tank should have no sharp edges that will come in contact with the body of the man carrying it on his back. It should preferably be equipped with a handle for carrying.

122. Shoulder straps should be adjustable, 2 to $2\frac{1}{2}$ inches wide, strong and of such weight and construction as to prevent curling or rolling at the edges. Adequate fastenings shall be provided for these straps and so attached to tank that leakage, breakage, or failure is impossible under severe use.

SECTION 2. POWER PUMPS.

General.

201. The best all purpose type of pump for contending with forest fires is the portable power pump. This is a self-contained unit consisting of a pump and a gasoline driven motor. It should be light enough in weight so that it can be carried easily by one to four men. The lighter in weight it is the better, so long as it meets other requirements. The superiority of the portable pump lies in its mobility and resultant ability to operate wherever a water supply is available. It can be taken by men to a swamp hole, woods stream, or other source of water inaccessible to an automobile. This fact often makes a pump of this character valuable also in handling building fires in rural territory. It can draft from water supplies that cannot ordinarily be reached by municipal fire apparatus.

202. Dependability is the prime requisite in a portable power pump motor. It is more important than any other factor. The motor, therefore,

should be of a type of generally recognized reliability in starting under all weather conditions. This feature should be thoroughly investigated before equipment is purchased.

203. The kind of power pumps needed by any community subject to brush or forest fires will depend upon:

- (a) The distribution and availability of open water in the brush and forest territory.
- (b) The extent, distribution, and the passability of its roads during the forest fire season
- (c) The topography and accessibility of the wooded and brush country.

Due to a complexity of conditions within their geographical limits, some communities may need more than one type of pumping outfit.

Adaptability of Pumps to Specific Conditions.

211. ROUGH AND RELATIVELY INACCESSIBLE, BUT WELL-WATERED REGIONS.

In territory of this character the pump may have to be transported part of the distance on men's backs. Weight, accordingly, is a controlling factor in its design and utility. Sturdiness, dependability, and simplicity of operation are prime essentials.

In addition to the portable power pump, the following equipment is needed.

- (a) 1500 to 5000 feet of hose.
- (b) Hand tools such as shovels, axes, fire rakes, grub hoes, etc., sufficient for at least 10 men.
- (c) Eight or ten hand pumps.
- (d) A truck of sufficient size, power, and clearance to carry this material over the roads of the region.

212. COUNTRY WELL SUPPLIED WITH OPEN WATER AND ALL PARTS FAIRLY ACCESSIBLE DUE TO A FAIRLY DENSE NETWORK OF PASSABLE ROADS.

More fires occur in this type of territory, particularly if it is densely populated, and menace buildings as well as the woods. The best equipment that the community can afford to buy is recommended. It is possible under these conditions to transport pumps by automobile to water or close by it. The weight of the portable power pump need not, accordingly, be such a controlling factor in its choice.

Experience indicates that the following combination makes the best all round outfit:

- (a) A forest fire truck carrying a water or booster tank of 100 to 150 gallons capacity. (See Section 3 of this report, Truck No. 1.)
- (b) A pump attached to the truck and driven by the truck motor. The primary purpose of this pump is to draw water from the tank and discharge it in a small stream at high pressure along the edge of a running fire while the truck is standing still or is moving at a low rate of speed along the fire. It can also be used for drafting and discharging larger volumes of water from a stream, pond or other source of supply.
- (c) A portable power pump fitted to take water from any available source.
- (d) Eight or ten hand pumps.
- (e) 1500 to 5000 feet of hose.
- (f) Hand tools such as shovels, axes, fire rakes, grub hoes, etc., sufficient for at least 10 men.

213. COUNTRY LACKING IN WATER BUT TRAVERSED BY A GOOD SYSTEM OF ROADS.

The type of equipment indicated for this territory is much the same as that described in Section 212 except that the automobile truck should be a heavy duty type equipped with a water or booster tank of 300 or 350 gallons capacity. (See Section 3 of this report, Truck No. 2.) A portable power pump capable of high pump pressures is essential.

Portable Pump to be Carried by One or Two Men.

221. The weight shall not be over 125 pounds, including pump, engine, and gasoline tank. If total weight is over 70 pounds (a weight which can be carried on the back of a man), the design shall be such that the motor and pump are quickly separable and rejoinable and self-aligning. No such separable part shall weigh over 70 pounds. Equipment shall be arranged for ready carriage by two men.

222. Pump shall be carefully designed in accordance with the best modern practice having preferably 2-in. suction intake. 1½-in. discharge connections shall be provided with reducer to suit smaller hose size, if required. Intake and discharge fittings shall have male thread with truly turned ends to take a gasket and shall be furnished with chained cover caps. Pump shall be fitted with a pressure gauge on discharge side that will register up to 300 pounds.

223. Pump and motor shall be able to deliver not less than 15 gallons of water a minute against a net pump pressure of 200 pounds per square inch. Pump must be able to prime itself promptly, and to take suction with a lift of 18 feet.

224. After being given a preliminary run of fifteen minutes, this pump shall be capable of delivering for one additional hour 15 gallons of water per minute against a net pump pressure of 200 pounds per square inch at the pump discharge outlet. No undue heating, loss of power, excessive strain or vibration, or other evidence of weakness shall develop during this test.

Portable Pump to be Carried by Two or Four Men.

231. Weight shall be not over 250 pounds including pump, engine, gasoline tank, and base. It need not be separable into 70 pound portions. It should be equipped with handles so two men can lift it around and four men carry it readily.

232. Pump shall be carefully designed in accordance with the best modern practice having 2-in. suction intake. 1½-in. discharge connections shall be provided with reducer to suit smaller hose size, if required. Intake and discharge fittings shall have male thread with truly turned ends to take a gasket and shall be furnished with chained cover caps. Pump shall be fitted with a pressure gauge on discharge side that will register up to 300 pounds.

233. Pump and motor shall be able to deliver not less than 35 gallons of water a minute against a net pump pressure of 200 pounds per square inch. Pump must be able to prime itself promptly, and to take suction with a lift of 18 feet.

234. After being given a preliminary run of fifteen minutes, this pump shall be capable of delivering for one additional hour 35 gallons of water per minute against a net pump pressure of 200 pounds per square inch at the pump discharge outlet. No undue heating, loss of power, excessive strain or vibration, or other evidence of weakness shall develop during this test.

Portable Pump to be Carried by One Man Alone.

Something should be said for smaller portable power pumps. These have proven very effective pieces of equipment under some conditions. The advantage of such a pump lies in its easy portability and in the small size of the hose. In all probability, equipment of this type will come more and more into use.

241. Weight shall be well within the carrying capacity of one man.

242. Pump shall be carefully designed in accordance with most modern practice. Intake and discharge fittings shall be suitable for use with $\frac{3}{8}$ -in. hose, and shall be furnished with chained cover caps.

243. Pump and motor should be able to deliver 5 to 10 gallons of water a minute against a net pump pressure of 200 pounds per square inch. Pump should be able to prime itself promptly and to take suction with a lift of 18 feet.

SECTION 3. MOTORIZED FOREST FIRE TRUCKS.

In order to meet varying requirements for motor forest fire fighting apparatus the N.F.P.A. Forest Committee has prepared specifications for two forest fire trucks. Truck No. 1 is intended for use in country well supplied with water and fairly accessible with passable roads or in country where, due to topographical conditions or poor roads, a large truck cannot be easily handled. Truck No. 2 is intended for use where good roads are available and/or where, due to meagre water supplies, it is desirable to provide a water tank of greater capacity than would be possible with Truck No. 1. The construction of both trucks shall be rugged, dependable and in accordance with approved automotive engineering practice.

The following general requirements are intended for both types of trucks and should be considered as part of the individual specifications.

Chassis.

301. Tires shall be of pneumatic heavy duty type of such size that the manufacturer's load allowance will not be exceeded. All tires should be of the same size. The spare tire shall not be carried under the truck frame.

302. Road Clearances (Loaded) and Overhang. The clearance of the transmission system under the truck (including the rear axle) shall be not less than 9 inches. The rear step clearance should be not less than 50% of the overhang back of the rear axle. Running board clearance shall be not less than 14 inches.

303. The following general provisions for the truck chassis are recommended:

The total weight of body and load shall not exceed the truck manufacturer's body and load weight allowance.

Load distribution—not more than 75% on rear axle.

The tread of the truck shall be the same both front and rear.

A windshield of non-shatterable glass shall be provided for the protection of the driver and an enclosed cab is recommended.

Niggerhead drums built on two rear wheels are desirable. By means of these and a $\frac{3}{4}$ -in. manilla rope, truck can pull itself out of a bad mud hole.

Booster or Water Tank.

304. The booster or water tank shall be mounted at the rear of the cab at the front of the body. This tank shall be constructed of not less than 14-gauge metal, preferably steel welded, and protected from corrosion on the

inside with two coats of red lead or equal protection. Baffle plates sufficient to prevent rapid shifting of water should be placed crosswise and lengthwise of tank and securely attached to its walls.

The top of tank should be slightly dished with a filler opening at least six inches in diameter at its center. Opening to be fitted with a deep-set screen and snug cap. One or more vents so arranged as to prevent water from splashing out but allow air to enter must be provided at high points of tank.

A 1½-in. outlet shall be provided in bottom of tank for a suction line to pump. A pipe, not less than 1-inch in diameter, for draining tank and filling hand pumps should extend from the bottom of tank to side or rear of truck. This should be fitted with a faucet of the self-closing type.

The tank shall be securely fastened to the truck to prevent strain due to surging of water in tank especially when truck is brought to a sudden stop. Fastening by means of strap iron and bolts is recommended. The use of brake lining between the bunks and the tank and between the iron straps and tank is also recommended.

Pump.

305. The truck shall be provided with a pump connected to the transmission or to the crank shaft of engine at the front end.

Pump Drive.

306. The pump shall be so attached that it will be possible to operate the pump whether truck is moving or stationary. If pump is driven by power take-off from transmission of truck engine, the power take-off shall be provided with approved clutch or gear shift by which pump can be quickly started and stopped.

Fittings and Piping.

307. The following fittings and piping shall be provided:

(a) Automatic relief valve or pressure regulator in discharge line of sufficient size to prevent appreciable rise in pressure when pump discharge is quickly closed while pump is operating at maximum capacity. Relief valve may by-pass either into the water tank or into the suction side of pump. Adjustment of relief valve should be enclosed.

(b) A hand operated relief or "churn" valve in addition to the automatic relief valve specified above. It may be used in filling the water tank.

(c) Pressure gauge in discharge line. It should be so mounted as to be easily visible to operator of pump.

(d) Piping to provide for drafting from either the water tank on the truck or from a water supply. Inlet from tank should contain a six-inch length of hose to reduce vibration. Piping shall provide for pumping directly into tank from water supply at no pressure head.

(e) Suction hose connections on both sides of truck or at front. Two-inch suction hose will be adequate for most conditions of forest fire service, but 2½-in. suction will be required if the truck is to be used for fighting building fires where there may be hydrants available or if the pump exceeds 100 gallons per minute capacity. 2½-in. connections may be useful if municipal or industrial fire apparatus is called to assist and a 2½-in. hose line may be used to relay water to the truck. A convenient arrangement is to provide a 2½-in. suction connection with a reducing fitting for smaller suction. Suction hose connections shall be provided with chained cover caps.

(f) A screen of ample capacity so placed in the suction system that all water drafted will pass through it. It shall be readily accessible for cleaning.

(g) 1½-in. discharge hose connections on both sides of truck, each fitted with a chained cover cap. There shall also be a ¾-in. discharge hose connection on each side of truck.

(h) Circulating water type cooling system in conjunction with radiator and fan preferred. If cooling water is taken from the pump, the piping shall be so arranged that the water will discharge back into the suction side of the pump.

(i) All inlets and outlets should be provided with bronze shut-off valves.

Hose Body.

308. A substantial body large enough to carry the hose, portable pump and miscellaneous equipment for a crew of ten men should be provided on the truck. A hose reel, or reels, having a capacity of 300 to 500 feet of high pressure ⅝-in. or ¾-in. hose should be mounted on the truck in a convenient place. The reel, or reels, shall be so constructed that water may be discharged through the hose while still on the reel.

Portable Power Pump.

309. A portable power pump is an essential part of this equipment. Either one of the two previously discussed in this report is recommended. (See page 7.)

Hose and Nozzle Equipment.

310. Two or more 10-foot lengths of suitable suction hose shall be provided for the pump on the truck and for each portable pump in the outfit. A six-inch galvanized iron, copper, or brass strainer should be coupled on the intake end of this hose.

1500 to 5000 feet of discharge hose, of a diameter best suited to local conditions, shall be provided together with 300 to 500 feet of high pressure ⅝-in. or ¾-in. hose. Hose and couplings must be able to withstand a working pressure of at least 250 pounds per square inch. An adequate assortment of hose coupling adapters shall be provided to meet the local conditions as to hose and hydrant sizes and threads. Reducers shall also be provided to meet the needs for the power pumps, piping, and hose carried.

311. For ⅝-in. or ¾-in. hose not less than two nozzles, adjustable from ⅛-in. to ¼-in. tip openings, or a combination of two or more nozzles or tips suitable to vary type and volume of stream without delay, shall be provided. For 1-in. to 1½-in. hose at least one nozzle shall be provided for each line of hose laid out. These should be provided with tips having openings of 3/16-in., ¼-in., 5/16-in., and ⅜-in.

312. Siamese or "Y" connections shall be provided permitting the division of a single hose line into two or more hose lines. At least two 2-way "Y" connections should be carried on the truck. These should preferably be gated and capable of being shut off.

Hand and Other Equipment.

313. At least six 5-gallon knapsack pumps of the type previously described shall be provided, together with an assortment of hand tools best suited to the region such as shovels, rakes, etc., sufficient for a crew of ten men. Other equipment should be as follows:

Complete set of tools for truck and portable pump.
Extra set of spark plugs for truck and portable pump.
150 feet of $\frac{3}{4}$ -in. manilla rope.
Supply of gasoline and oil for portable pump.
1 electric lantern.
1 carbon tetrachloride $1\frac{1}{2}$ -quart extinguisher.
1 first aid kit.
1 substantial water-proof canvas bag or tank of 100 gallons or more capacity for use when relaying water with two pumps.

Mounting.

314. All equipment shall be so mounted that it will not be subject to damage, and be arranged for quick removal and use. All operating controls shall be placed consistent with convenience and safety.

Tests.

315. The apparatus shall be run a sufficient length of time before delivery to withstand the following tests without overheating the motor or harming the apparatus in any way.

316. ROAD TESTS: The apparatus fully loaded with equipment to be carried and four men shall meet the following tests:

(a) It shall make a run of any selected route, including only roads in good condition and not including any grade over 10%, during which a maximum speed of 40 miles per hour and an average speed of at least 20 miles per hour shall be obtained.

(b) While running at road speeds from 1 mile per hour to 6 miles per hour the pump shall demonstrate its ability to deliver a satisfactory fire stream. (For Truck No. 1 see par. 326; Truck No. 2, par. 336.) During the test the apparatus shall be stopped and started and gears shifted without seriously interrupting the flow from the nozzle.

(c) The brakes must stop the apparatus while fully loaded within the limits specified by the State Highway authorities.

317. PUMPING TESTS. The pump shall deliver its rated capacity in gallons of water per minute against a net pump pressure of 120 lbs. per sq. in. for a continuous period of one hour, with a suction lift of not more than 10 feet, followed by a one-half hour period of continuous pumping, during which at least one-half of the rated capacity shall be delivered at a net pressure of 200 lbs. per sq. in. During and after the tests, the motor, pump, transmission and all parts of the machine shall show no undue heating, excessive strain or vibration, and motor shall show no loss of power, over-speed or other defect.

The relief valve or pressure regulator shall be set and while the pump is delivering capacity, discharge gates shall be closed without resulting in excessive pressure at the pump. This test shall be made with the relief valve or pressure regulator set at 100, 150 and 200 pounds.

Special Requirements for Truck No. 1.

These specifications contemplate a motor fire truck having a chassis of not more than 7000 pounds manufacturer's gross load capacity carrying a water tank, high pressure pump, two high pressure hose lines with nozzles of small capacity for use in connection with water tank while the truck is moving or stationary. Provision shall be made for use of $1\frac{1}{2}$ -inch hose lines with suitable nozzles to be used while pumping from a water supply while truck is stationary. These specifications are not intended to be sufficiently detailed to use for bidding, but rather to serve as a basis for the main requirements to be met by the apparatus.

Chassis. (See also general requirements.)

320. ROAD SPEED (with normal load): From not more than one (1) mile per hour to not less than forty (40) miles per hour. Continuous operation.

321. The engine shall develop not less than 40 B.H.P. at not to exceed 2400 R.P.M. of engine.

322. The electric lighting and starting system shall be of approved design operated by battery or magneto ignition system of approved type.

323. The gear ratios shall be such that the lowest road speed shall not exceed $2\frac{1}{2}$ M.P.H. with suitable engine speed to propel the truck and drive the pump. The truck shall be able when fully loaded to negotiate grades of 25% while pumping.

Water Tank. (See also general requirements.)

324. The capacity of the tank shall be from 100 to 150 gallons. The center of the tank shall not be more than 12 inches above top of truck frame.

Pump. (See also general requirements.)

325. The rated capacity of the pump shall be not less than 30 gallons per minute at 120 pounds pump pressure. It shall be able to take suction with a lift of not less than 18 feet with a dry pump.

326. The pump speed shall be sufficient to discharge not less than 20 G.P.M. at 50 pounds pressure when the road speed is not more than $2\frac{1}{2}$ miles per hour.

Special Requirements for Truck No. 2.

These specifications contemplate a motor fire truck having a chassis of not more than 11,000 pounds manufacturer's gross load capacity carrying a large size water tank, high pressure pump, two high pressure hose lines with nozzles of small capacity for use in connection with water tank while the truck is moving or stationary. Provision shall be made for use of $1\frac{1}{2}$ -inch hose lines with suitable nozzles to be used while pumping from a water supply while truck is stationary. These specifications are not intended to be sufficiently detailed to use for bidding, but rather to serve as a basis for the main requirements to be met by the apparatus.

Chassis. (See also general requirements.)

330. ROAD SPEED (with normal load): From not more than one (1) mile per hour to not less than forty (40) miles per hour. Continuous operation.

331. The engine shall develop not less than 65 peak B.H.P.

332. The electric lighting and starting system shall be of approved design operated by battery or magneto ignition system of approved type.

333. The gear ratios shall be such that the lowest road speed shall not exceed $2\frac{1}{2}$ M.P.H. with suitable engine speed to propel the truck and drive the pump. The truck shall be able when fully loaded to negotiate grades of 25% while pumping.

Water Tank. (See also general requirements.)

334. The capacity of the tank shall be not less than 300 gallons. The center of the tank shall not be more than 15 inches above top of truck frame.

Pump. (See also general requirements.)

335. The capacity of the pump shall be not less than 100 gallons per minute at 120 pounds pump pressure. It shall be able to take suction with a lift of not less than 18 feet with a dry pump.

336. The pump speed must be sufficient to discharge not less than 30 G.P.M. at 50 pounds pressure when the road speed is not more than $2\frac{1}{2}$ miles per hour.

SECTION 4. HOSE.

Forest fire fighting subjects hose to hard usage. Hose used for this service is commonly transported long distances and often is laid over rough, brushy and rocky terrain. Hose capable of withstanding severe treatment is in general too heavy and bulky for transportation to and handling at forest fires. Hose that is lighter in weight, less bulky and more pliable is better suited for forest fire service even though it may be less rugged. Two kinds are in common use, $1\frac{1}{2}$ -inch linen and $1\frac{1}{2}$ -inch single jacket cotton rubber lined. Both kinds have their adherents. The favorable and unfavorable features of each appear to be as follows:

Unlined Linen Hose.

401. Favorable features.

- (a) Light weight.
- (b) Small bulk. Unlined linen hose will roll into small compact rolls (some makes even when wet). More hose can be carried on a truck than when using rubber lined hose.
- (c) Costs less than rubber lined hose.
- (d) Leakage of water through fabric affords some protection to hose when dragged through hot embers.
- (e) When properly stored will last indefinitely.

402. Unfavorable features.

- (a) Larger friction loss compared with rubber lined hose.
- (b) Leakage of water through fabric means less water delivered at nozzle. Until hose is thoroughly saturated travel of water from pump to nozzle is retarded.
- (c) Unlined linen hose must be thoroughly cleaned and thoroughly dried after use or it will mildew or rot. It has been the general experience that it does not ordinarily get the care that it needs with the result that it does not stand up as well as cotton rubber lined hose.
- (d) Difficulty is often experienced in finding, under field conditions, suitable storage facilities for unlined linen hose, particularly in humid climates.

Cotton Rubber Lined Hose.

403. Favorable features.

- (a) Less friction loss than with unlined linen hose.
- (b) No water loss through fabric by seepage.
- (c) Thorough cleaning of outer jacket not so essential as with linen hose.
- (d) Generally believed to withstand more hard usage than linen hose.