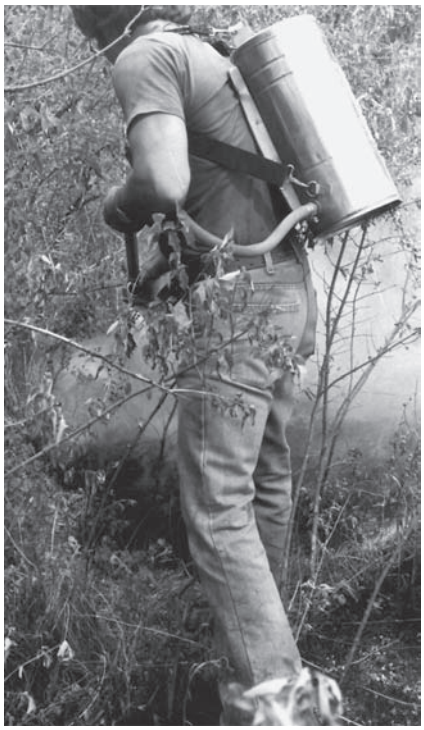
PRESCRIBED BURNING

EQUIPMENT



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Prescribed burning sometimes requires unique equipment, but often common tools and equipment can be adapted for effective use. In selecting and evaluating equipment for a prescribed burn, it is important to understand the purpose and design requirements of each piece. Two kinds of equipment are needed for prescribed burning: that used to suppress or control the fire, and that used to ignite the fire.

Suppression Equipment

Suppression equipment includes many items that can be used to extinguish or control a fire. Some are large, expensive pieces that may also be used for other work. Others are highly specialized pieces that can either be purchased or made. For some purposes, common hand tools can be used.

The Pumping System

All components in the pumping system must be compatible and complement each other. Minimum requirements have been established as a guide for determining the capabilities of fire fighting equipment. For a rural grass fire unit, the nozzle, hose, pump, engine and tank must deliver at least 6 gallons of water per minute (gpm) at 125 pounds per square inch (psi) of pressure. A unit delivering less than this is limited to working small fires, such as firebreaks, flank fires and others with flame lengths of less than 6 feet. Large, hot fires require equipment capable of reaching out with enough volume and pressure to knock down the fire in order to put it out.

Tanks. The first requirement for most prescribed burns is an adequate source of water. As a minimum, a 200-gallon water tank securely anchored to the vehicle is needed. There should be absolutely no movement of the tank. Unsecured tanks have been known to cause injury to the driver and severe damage to the cab of vehicles during emergency stops. The tank can be constructed of steel, fiberglass, or plastics. Baffling in the tank is necessary, especially on pickups and trucks, to prevent both front-to-back and side-to-side movement of the water.

Pumps. The unit's engine and pump should be separate from the vehicle engine. That way, if the vehicle becomes disabled in a dangerous situation, there will still be a means of protecting people and equipment. The minimum requirements of 6 gpm at 125 psi must be kept in mind when selecting a pump.

Hoses and Nozzles. Hose size, hose length, hose material, nozzle design and nozzle capacity are critical considerations in equipping a pumping unit. Careful thought must be given to selecting hoses and nozzles to make maximum use of the engine and pump capacity.

Hose diameter. A hose with a ¾-inch inside diameter (ID) is considered a minimum. Smaller diameter hoses carry considerably less water. For example, a ⅝-inch ID hose will carry only about 70 percent of the water a ¾-inch ID hose carries. A ½-inch ID hose will carry about 45 percent of the water a ¾-inch hose carries. The sample chart in Figure 1 illustrates the relationship of hose diameter, flow rate and pressure loss. Each hose manufacturer's chart may be slightly different. First, determine the pressure and flow rate you want for the nozzle, and the hose length and diameter you plan to use. From the chart, determine the pressure loss for that hose length and diameter. Add the pounds of pressure loss to the pounds of pressure you desire at the nozzle. This is the pressure your pumping unit must produce to achieve the desired flow rate.

For example, suppose you want 45 psi and a flow rate of 30 gpm at the nozzle, and you'll be using 100 feet of ¾-inch ID hose. From the chart in Figure 1, you'd use the ¾-inch

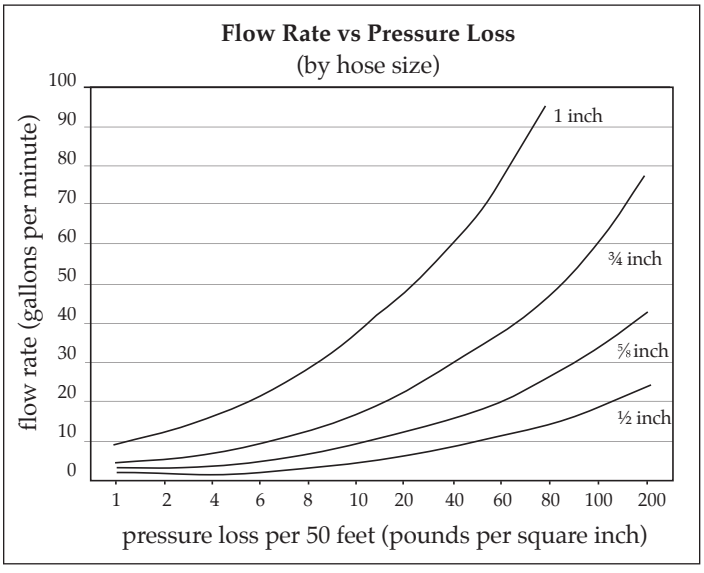

Figure 1. *Pressure loss in a hose is important in selecting the size and length of hose to use. For each 50 feet of hose desired, determine the pressure loss per 50 feet plus 10 percent for each coupling.*

line at 30 gpm, and find that the pressure loss per 50 feet of hose is about 40 pounds. For 100 feet of hose, the pressure loss would be twice that much, or 80 pounds. Add that to the 45 pounds of pressure you want at the nozzle. The result is that you'd need a pump capable of 125 psi.

Hose length. A hose length of 50 feet should be considered a minimum. Longer lengths should be considered when:

- large, escaped fires are to be extinguished, or
- steep slopes, wooded areas, and other areas inaccessible to a vehicle are included in the burn area, requiring additional hose length to reach.

Hose material. The hose should be rated at least for the pressure that the pump produces. It should be made of a material that wears well under the conditions of prescribed burning. Rubber hoses reinforced with synthetic fibers or metal mesh are the most reliable.

Hose storage. A method of storing the hose on the unit will help reduce hose wear and keep it ready for use. Either a stationary bracket or a hose reel adds to the effectiveness of the unit. A reel (Figure 2) will allow quick changes in the hose length and prevent dragging of the hose. Dragging is the most common reason for hose failures.

Nozzles. The final part of the pumping unit is the nozzle. The amount of water delivered through the nozzle determines the usefulness of the unit. Nozzles should allow adjustment for volume and output pattern (straight streams, spray and fog patterns). Most agricultural nozzles are not designed to deliver the volume needed for fighting relatively large fires (flame lengths over 6-8 feet). Remember, to safely fight a large fire, the pumping unit must deliver a minimum of 6 gpm at a pressure of 125 psi. Units that cannot deliver this are adequate only for use in burning firebreaks, controlling small fires around the perimeter and in mop-up. Figure 3 shows examples of some common nozzles available.

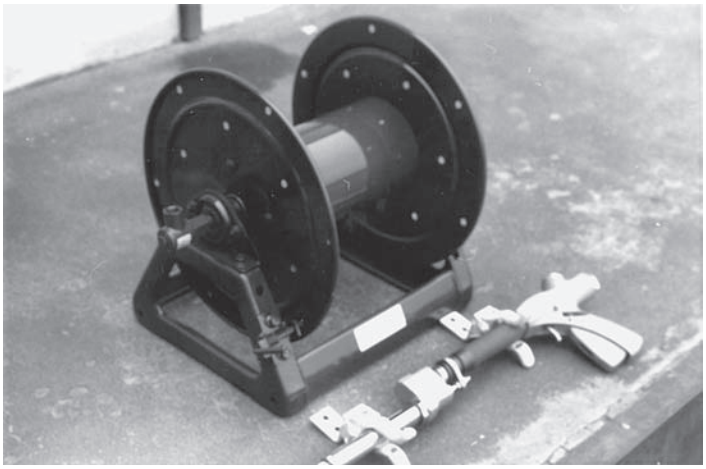

Figure 2. *A reel or rack is desirable for storing the hose on a sprayer. In addition, a means of firmly securing the nozzles is desirable.*

Figure 3. *The flow capacity of agricultural spray nozzles varies greatly. Of those pictured, only the top (FMC #785) and the second (FMC #240 of Hypro #3381-0010) are rated above the 6 gpm at 125 psi.*

Vehicles

The vehicle carrying or towing the pumping unit must also meet certain standards. Pickups and trucks should observe weight limits closely. Avoid overloading. Table 1 provides general guidelines on load limits.

Trailers should carry only the weight for which they are designed. The pumping unit, including the tank, should be mounted as low as possible on the trailer. The towing vehicle or tractor should be rated and equipped for the

Table 1. *Suggested guidelines for tank sizes on vehicles. Pumping unit weight (tank and pump) is included.*

Load limit	Maximum tank size
½ ton	150 gallons
¾ ton	200 gallons
1 ton	300 gallons

weight of the trailer unit. Tires must be in good shape and have adequate ply to carry the load.

In all cases, the tanks should be baffled and the unit securely anchored.

Fire Fighting Backpacks

Several special fire fighting backpacks have been developed. They are used to follow vehicles or to get into places where vehicles cannot. The backpack should provide a shield between your back and the tank. This helps insulate your back from extreme water temperature and allows air flow to cool it. The backpack has a baffle in the tank to allow body movement and reduce extreme water movement in the tank. A water/detergent mixture should always be used in the tank. A strainer in the filler opening is critical. Pure, clean water is not always available and any contaminants in the water that pass through the strainer usually will go through the pump.

The pump is most often a trombone type with a two-orifice nozzle. The pump fills when the plunger is pulled out and pumps when it is pushed in. It is pumped with one hand from behind while the other hand is on the plunger, controlling the direction. The best pumps are chrome-plated brass or stainless steel.

Soft tanks made of PVC fabric, rubber or coated nylon are lighter and more comfortable than stainless steel tanks. Care must be taken to keep the soft tanks protected from sharp objects that can tear the material.

Hand Tools

A number of useful hand tools have been developed by agencies and fire fighters. Each has a special use and can play a role in prescribed burning.

Fire swatter. The fire swatter is probably the best hand tool to use. The swatter is properly used by placing it gently but firmly on small flames, causing the fire to be smothered. If the swatter is slapped down, the air is forced out from under the flap, moving the burning material and causing the fire to spread. Once an individual masters the use of the swatter, small fires can be put out quickly, especially in light fuels.

Fire swatters can be purchased at reasonable prices from fire equipment dealers. They are also easy to make. Begin with a 12-by-15-inch piece of rubber belting (it must be rubber belting), two pieces of strap iron with rivets, and a piece of rod welded to the strap iron at the same angle as a shovel handle is attached to its scoop. The rod will accommodate a yard tool handle available in any hardware store.

Grain scoops will accomplish the same thing. If they are aluminum, don't leave them on the fire very long or a hole will suddenly pop in them. The flat-nose, flat-backed, long-handled shovels also do a good job.

Rakes. Various rakes can be used effectively in prescribed burning. Each has a specific use.

Fire rakes, also called council rakes, can be used to rake, dig or cut. They are used in places where it is difficult to go with other equipment. Fire rakes can be made by attaching four mowing matching sections to a piece of ½-inch angle iron with a ring welded on top of it. A hoe handle is then inserted into the ring. Fire rakes also can be purchased.

A leaf rake or garden rake can be used to create a bare soil line for a firebreak in tree lines or similar areas where fuel consists mainly of a mulch with no grass. The leaf rake is used to rake the material off the soil to get a bare soil surface. That's the beginning of a firebreak. Special fire rakes made of steel or fire-resistant materials are also available.

Buckets. One other item needed when burning near fences or power poles is a five-gallon plastic bucket with a tight-fitting lid. Put a water/detergent mixture and a supply of burlap bags into the bucket. If a pole or post starts to burn, take one of the burlap bags and wrap it around the object. This cuts off oxygen, and begins cooling the wood. Water can then be applied to the wood. Water alone, however, cannot extinguish a burning pole or post.

Fire Retardants

Fire retardants are chemicals (ammonium polyphosphate) that prevent materials from burning. The fuels will char under high temperatures but will not flame. Fire retardants are used to develop firebreaks and protect areas.

Commercial formulations such as PhosChek are available. These materials contain ammonium polyphosphate plus emulsifiers, corrosion inhibitors and a dye.

Ammonium polyphosphate liquid fertilizer also can be used. Local fertilizer dealers usually can supply the ammonium polyphosphate or 10-34-0. Mix the liquid fertilizer as a 10 percent solution in water (1 gallon fertilizer to 9 gallons water). The mixture is sprayed on short fuel, preferably a mowed line with most of the trash removed. All the vegetation must be coated to prevent burning. One hundred gallons will usually cover about a half-mile of a 24-inch-wide mowed line. To be most effective, mow the line about 3 inches high.

Two problems are associated with the fertilizer mixture. First, it is extremely water soluble. A light rain or heavy dew will remove it from the vegetation. It must be applied just before it is needed. Second, it accelerates corrosion. Do not leave the mixture in a metal sprayer overnight. Wash out the tank and sprayer with soap and water and rinse it well. One way of disposing of the extra mixture is on lawns or fields.

Wet Water Agents

Liquid dishwashing detergents, such as Ivory, Joy or Dawn, can be used to make water more effective. Once the sprayer tank is filled and agitating, add about 1 ounce of the detergent per 100 gallons of water. Most water is hard enough that additional detergent may be needed. Start adding small amounts until the water feels slick to touch. If suds develop when pumped, too much detergent has been added. The detergent breaks down the surface

tension of water and allows it to spread and penetrate a surface much better. Detergent at least doubles the effectiveness of water alone. A 100-gallon tank of water with detergent will perform like a 200-gallon tank. It's an economical way of stretching water. When conducting a prescribed burn, detergent should be added to all water-using equipment.

Foam

Class A foam is a relatively new water additive that has several benefits. It can be mixed with water at the rate of 0.2–1.0 percent and sprayed through a regular nozzle. Thicker foam can be generated with a special nozzle that injects air into the water/foam stream. The nozzles are relatively inexpensive.

The white-colored foam reflects heat from the unburned fuel and the additive produces the same water-stretching advantages as detergent.

Using Fire Suppression Equipment

When using water, whether in a backpack or mounted pumper unit, use a narrow fan spray, and work along the fire line from the burned side. As you work from the black (burned) side, any water sprayed over the fire goes onto unburned material. Water sprayed on ash is wasted. To move rapidly along a fire line, use a pumper unit to knock down most of the fire. Follow the pumper unit with a backpack to extinguish the rest of the fire; then use hand tools to ensure that the fire is out and reduce the use of water.

Ignition Equipment

A drip torch (Figure 4) is a special device developed for the purpose of igniting fires. It has a tank with about a 5-quart capacity and a special handle that is comfortable to carry when starting the fire. There is an air valve with a tube inside that goes to the bottom of the tank so that when the torch is in the burning position, air is introduced into the tank above the fuel mixture and not bubbled through it. A drip torch also has a filler cap and flow valve. Attached to the flow valve is the burning wand. On the end of the wand is a pad saturated with the fuel mixture.

Figure 4. *A drip torch is one of the fastest and safest methods of igniting prescribed burns.*

When lit, the fuel mixture drips across the pad by gravity, ignites, falls into the dry fuel (grass, litter, and such) and starts the fire. The safety loop on the wand provides protection. When in use, the safety loop is always filled, creating a liquid lock that prevents flashbacks into the tank. The drip torch has been in use about 50–60 years. It is a well-designed, safe piece of equipment. The fuel mixture to use is 1 part gasoline to 3 parts diesel. If the fuel is very flashy use 4–5 parts diesel to 1 part gasoline to reduce the rate of burning.

Propane torches have been used as well, both small hand torches and hand burners connected to larger tanks. The biggest drawback with the propane torch is its tendency to spread the heat generated over a large area and thus ignite only the tops of vegetation. In addition, the bulk of large tanks, extensive efforts required to maintain hoses and the cost of small hand torches favor the use of drip torches.

Summary

Proper equipment is necessary for conducting a safe prescribed burn. Always check to make sure the equipment is in working condition before starting a fire.

Brand names appearing in this publication are used for product identification. No endorsement is intended, nor is criticism of similar products not mentioned.

Other Useful Publications

Prescribed Burning: A Management Tool (L-815)
Prescribed Burning: Planning And Conducting (L-664)
Prescribed Burning: Safety (L-565)

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