During wildland firefighting operations firefighters occasionally fight the fire with fire. In situations where the flame length exceeds 15’ or the fire intensity (heat release) is too intense for direct attack, it is appropriate to either backfire or burn out an area.

Backfiring or burnout operations are often critical operations in the control of a wildland fire. If planned and executed correctly, they can speed control of a fire and greatly reduce suppression costs. Conversely, if done incorrectly, they can endanger personnel, extend control time and increase cost. Safety considerations must always be given first priority.

As a wildland firefighter, it is essential that you understand the concepts presented in this section and wildland fire behavior before getting involved in any firing operation. As a general rule, only adequately trained qualified personnel should conduct burning operations.

Firing Operation Approval

The authority to conduct Backfire operations is addressed in California Public Resource Code Section 4426 as identified below:

4426. A person shall not set a backfire, or cause a backfire to be set, except under the direct supervision or permission of a state or federal forest officer, unless it can be established that the setting of such backfire was necessary for the purpose of saving life or valuable property.

It is necessary to acquire approval, through the chain of command, from the Incident Commander, Operations Section Chief, or Division Supervisor before proceeding with a backfire or burnout operation. The only exception would be an emergency situation to save a life or property. Some agencies do permit company officers to initiate burnout operations. Before going out on the fire line, determine your local agency policy regarding firing operations. Escondido Fire Department does not allow Company Officers to initiate firing operations except under exigent circumstances mentioned above.

One person, usually the Firing Group Supervisor, is focused on supervising the firing team and coordinates the firing operation. The Firing Group Supervisor should be experienced and highly trained in firing operations and always aware of safety and fire behavior. The Firing Group Supervisor, also known as the Firing Boss, must be constantly aware of weather changes, problem areas developing on the line, and fire intensities being created by the firing operation.
**Backfire**

A backfire is defined as a fire intentionally set along the inner edge of a control line to consume the fuel in the path of a wildfire and/or change the direction of force of the fire's convection column. Setting a backfire is a tactic usually used only when other fire control methods are judged impractical.

Backfiring is usually a preplanned event with sufficient resources available to hold the fire line during the firing. These holding force resources are held in reserve to rapidly attack any slope over and the process whereby spot fires.

![Backfiring Diagram](image)
Key Point
Most firefighters will be assigned to holding force activities. As such, the assigned personnel must work closely with the firing team and monitor the fire environment closely.

The main fire will influence the backfire. An in draft effect takes place as the main fire approaches the backfire’s flaming front. The main fire has a strong need for oxygen, as it generally has a strong convective column. Thus, the fire being lit will be drawn toward the base of the approaching larger main fire when you backfire. This is called the in draft effect.

A firefighter uses a drip torch. Notice the main fire in the background. When a backfire is planned, adequate time for the fire to move away from the control line must be allowed.

The amount of time required to burn the intervening fuel is based on fuel factors, topography, weather, and fire behavior. Holding forces must only flow enough water to control ember production and flame intensity as to not allow an escape. Flowing too much water and extinguishing too much fire on the backfire will be counterproductive to the overall operation. If the distance between the backfire and main fire are and fire behavior is too great, then consider the use of a counter fire.

Counter Fire
A fire set between the main fire and the backfire to speed the spread of the backfire. Firing devices used during firing operations include pistols, hand thrown flares, and aerial ignition devices.

During firing operations, always remember to proceed at a rate at which the fire you are lighting can be held.

There is no firm set of rules as to when to light the backfire. Firing timing is based on safety, fuels models, topography, existing fire conditions, and of course - weather. These factors must be evaluated and wildland fire prediction skills used to determine when the fire should be lit. It is important to use the most experienced fire crewmember for this operation.
Burnout

Burnout, or burning out, is defined in the fire line Handbook as "setting fire inside a control line to consume the fuel between the edge of the fire and the control line". The control line is not complete until all fuels have been removed between the fire’s edge and the control line. The intent is continuous “black line" along the entire perimeter.

Large islands of unburned fuel within the fire area and close to the control line must be removed before the line can be considered controlled. Burning out is an effective way to mitigate extensive line construction around pockets and fingers. Firefighters can burn out as they, or bulldozers cut line from fingertip to fingertip. This technique reduces the total amount of line that needs to be constructed.

Before Starting a Firing Operation

— Do not perform the operation if you are not qualified to do so, or are not comfortable with the current fire environment conditions.
— Obtain supervisor approval. Be sure that this operation is within established Incident Objectives.
— Insure that adequate resources are on hand to carry, hold, and control any fire that is set.
— Maintain compliance with FIRE ORDERS, WATCH OUT SITUATIONS, and LCES at all times.
Firing Team Organization
A firing operation should be organized and planned. Crews should be assigned to function as firing forces, holding forces, mop-up forces, and reserve forces. A complete briefing should be given to those crews involved in the operation. A well-organized firing operation’s organizational structure may look like this:

FIRING PERSONNEL ORGANIZATION CHART

INCIDENT COMMANDER OR OPERATIONS SECTION CHIEF

FIRING GROUP SUPERVISOR

FIRING FORCES  HOLDING FORCES  MOP UP FORCES  RESERVE FORCES

Firing Forces
These individuals while being cautious of their surroundings should devote 100% of their attention to the actual firing process. They do the actual lighting.

A complete briefing should be given identifying safety considerations, the ignition sequence, when the firing operation is to commence, what firing methods will be used.

Holding Forces
The main duties of the holding forces are:

— The protection of personnel and equipment from injury or damage from heat.
— Prevent the fire from spotting across the control line.
— Strengthen critical points of the control line.
Holding forces must have sufficient resources to rapidly attack any spot fires or potential problem areas without seriously reducing the actual holding forces where the backfire/burnout is occurring.

**Mop-up Forces**

After the firing and holding forces have moved down the line, the engines and crews that remain behind are the mop up forces. These crews must remain aware of spot fires occurring in the unburned (green) and remain alert for changes in the fire weather. Water conservation is important for the protection and safety of the firing and holding forces that have moved down the fire line.

These are resources that are left behind to secure the line as the actual firing progresses. They may start out as holding forces and as a section of line is fired, they simply remain for mop up.

**Reserve Forces**

These resources are held in reserve and do the following:

- Assist when needed in holding the line
- Act as a separate tactical unit to attack spot fires.
- Provide relief for the firing, holding, or mop up crews.
Fuel, Topography, And Weather Burning Considerations

The fire environment must be evaluated before the firing operation begins. Fuels, Weather, and topography are key to the intensity levels and flame lengths that will be created by firing operations. Never create more fire than can be controlled.

Fuels

Light fuels are generally readily available and can be ignited by the tools at hand. They generally produce low heat intensities on the fire line. They generally burn clean and spread rapidly. They can be held with a smaller control line than other fuel types. Of all the fuel types, light fuels (1-hour time lag fuels) are the most susceptible to a change in relative humidity. Therefore, their moisture content can change rapidly. This fuel type has a greater tendency to spot than other fuel types.

Medium fuels produce greater heat intensity and flame lengths than light fuels. The tools at hand can ignite them; however, they normally require a drip torch. This type of fuel is generally less susceptible to spotting than light fuels. Medium fuels are more readily ignited at night than light fuels due to the slower effect of humidity on them. These fuels require increased control line widths and an increased resource deployment to hold the line.

Topography

Topographic features probably represent the greatest obstacles to successful firing and may be deceiving. But it is a critical safety problem that must be considered. Topographic conditions usually dictate the feasibility for any decision to fire. Some topographical features can be very advantageous while others should signal "Watch Out".

Weather

Winds need to be evaluated when planning the firing operation. Firing with the wind, where the wind blows away from the control line, produces increased fire intensity and a more rapid rate of spread. More heat builds causing a strong convective column and perhaps more spotting. The flammable vegetation in the fuel's path can be removed by fire more quickly. It will take less time to complete the backfire/burnout operation. A smaller control line is needed to hold the firing operation.

When firing against the wind, it will take longer to complete the operation because the fire will spread at a slower rate. It will also be harder on personnel, because the smoke and heat will be blown back toward them.

Weather Concerns to Watch

— Be aware of any thunderstorm activity developing in the area.
— Evaluate the smoke stability and burning conditions. This will provide information on atmospheric stability.
— Monitor high level winds, as they may become surface winds later during the day.
— Watch for eddies created by topographic changes.

**Problem Areas**

**Mid-slope Roads**

— Spot fires can easily occur.
— Convected heat rising often requires crew and equipment protection to the exclusion of the holding effort.
— Usually extremely poor visibility for safety lookouts due to heavy smoke lying against the slope.
— Mid-slope roads call for extreme care as unburned fuel is either above or below the operation and there is a higher likelihood of spotting.

**Switchbacks**

— Switchbacks in constructed line with main fire down-slope have the same concerns as mid-slope roads.
— Tight inside turns will usually be in narrow canyons that can produce a dangerous chimney effect

**Firing Devices**

**Fusee**

These types of fusees have extension alternatives in the form of a cardboard sleeve on the rear portion of each fusee that allows them to be stacked and allows you to perform an extended operation.

Fusees must be kept dry. Whenever possible, transport them in their original containers. They are light, portable, and produce a hot flame. The phosphorus material burns at about 1400°F. Fusees can be broken and thrown and can also be relit. To extinguish them, place the tip into the dirt and snuff them out.

**Drip Torch**

A drip torch is a canister that drips ignited fuel from a spout. It works on all fuel types. The contents of the canister are a mixture of one-part gas to four parts of diesel fuel and last about one hour. This firing device is to be used with care, as it can create a lot of fire very quickly.
Instructions for Operating a Drip Torch

Lighting the Torch

— To light the drip torch, you need to get the wick doused with fuel. Be careful that you don’t splash fuel where you don’t want it.
— It is best to clear out a small area, and make a tiny pile of small sticks or grass. Tip the torch just enough to wet the wick and wet the small pile of grass.
— With your matches or lighter and light the small pile on fire. Dip the wick of the torch into this small fire to light the wick on fire.
— If you attempt to hold the torch in one hand and light the wick with the other hand, you may inadvertently splash fuel on yourself or into an unwanted area. Play it safe and always light the torch as described above.
— Place the spout in a position where the nozzle is on the same side as the handle. This position will allow the fuel to flow over the lit wick, causing ignition of the fuel.
— Hand-tighten the air vent and tank lock ring as over tightening may damage the O-rings.
Using the Torch

Once the wick is lit, carefully move to the area to be burned, always keeping the torch upright and the wick pointing AWAY from your body as you move. When you are ready to ignite, periodically tip the torch toward the ground so that fuel spills out onto the ground, getting lit by the wick in the process.

REMEMBER:

Do not light more fire than can be controlled by holding forces!

Firing Techniques

Line Firing

A firing technique where one strip is set along the inside edge of a control line. This is the safest technique.

Strip Firing

Setting fire to more than one strip of fuel and assuring that the strips burn together, thus widening your control line. Coordination and safety for the firing team are critical. Used primarily in light continuous fuels that produce low heat intensity.
Then using the strip firing technique, always evaluate what will be driving the fire you are lighting. It will either be the wind or the topography and this will dictate the firing order of the team members.

Pace, timing, coordination, and communication are KEY factors with a strip firing operation. The firing team moves parallel to the control line in a staggered formation to burn fuels. The ignited strips are allowed to burn together along a control line to a termination point.

**Ring Firing**

Ring Firing is a firing technique that works well in structure protection situations where we have pockets of houses with large areas of natural fuels between the homes and a flame front of several miles approaching.

"With this method we are splitting the head of the fire moving it around the structures you are protecting."
Ring Firing Reminders

— Be aware of fuels between you and main fire.
— Be sure there are not any resources between you and main fire.
— Communicate your actions as far ahead of operation as possible.
— Ring firing may be useful to create a safety zone to give yourself some "black" to hide in.

Remember

The information presented here is to provide general and basic information on firing!

The decision to backfire or burnout is made by evaluating alternatives and concluding that firing is the best option to undertake. You must first understand wildland fire behavior. The fire you light will act according to the effects of slope and wind.

Fire ground commanders should select their most experienced and highly trained crews to supervise and perform these operations.