

CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

TABLE OF CONTENTS

TABLE OF CONTENTS.....	1
LEARNING OUTCOMES - KNOWLEDGE	3
LEARNING OUTCOMES - SKILLS	3
BURNING OFF - AN INTRODUCTION	4
Goals	4
Principle of Parallel Attack.....	4
ENVIRONMENTAL CONDITIONS.....	5
Weather	5
Terrain	5
Fuel and Fuel Loading.....	6
Potential Fire Behaviour.....	6
RESOURCES AND EQUIPMENT.....	7
Air Resources	7
Ground Resources	7
Drip Torch	8
Set-up	8
Lighting Procedure	8
Use on the Line	8
Safety During Use:.....	9
Heli-Torch.....	9
Other ignition devices	10
Fusees	11
Aerial Ignition Device (AID Machine).....	12
PREPARING TO BURN.....	11
LACES	11
Resource Organization and Briefing	11
Control Lines	12
Water Delivery.....	12
THE BURNING OPERATION	12
Ground Crew Roles	13
Burn Supervisor	13
Nozzle Crew.....	13
Burn Off Crew	13
Mixing Crew	14
Crew Formation	14
Controlling the Burn	14
A Note About Prescribed Burning.....	15

CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

IGNITION TACTICS..... 18

 Goals 16

 Principle of Indirect Attack 16

 Basic Approaches 16

 Burning Out..... 16

 Burning Off..... 17

 Backfiring..... 17

 Classic Indirect..... 18

 Strip Backfiring 18

CONVECTION 19

 Topography..... 19

 Fire Size and Rate of Spread..... 19

 Timing..... 20

LEARNING OUTCOMES – KNOWLEDGE

At the end of this module, students will be able to:

- √ Explain the **goals and guiding principle** of using the parallel attack method to burn off;
- √ List the **environmental conditions** that must be considered when planning to burn off;
- √ Summarize **air and ground resources and equipment** commonly used in burning operations;
- √ Describe the **operational components** that are put in place when **preparing** to burn off;
- √ Describe **ground crews roles** during the burning operation;
- √ Explain how **burning off, burning out and backfiring** all differ and describe its **two basic approaches**;
- √ Define **convection** and explain how it is used in burning operations.

LEARNING OUTCOMES – SKILLS

During the field exercise and prescribed burn, students will be expected to demonstrate:

- √ Proper set up, lighting, and use of a **drip torch**;
- √ Effective utilization of a **control line** in a burning operation;
- √ Appropriate and safe **crew formation** during a burning operation.

BURNING OFF – AN INTRODUCTION

When the decision is made to conduct a burning operation, the fire is usually beyond the initial attack stage. Therefore, most small fires do not require burning off; this operation is done mostly on larger project fires. Before discussing how we actually prepare for and execute a burning off operation, it is first necessary to understand the **basic goals and principle** of this method of attack.

GOALS

Whether burning off or backfiring, the ultimate goal is the same: **remove all the available fuels so that the fire has nothing left to burn**. However, this is not always entirely possible due to factors such as terrain, burning qualities of fuels, changes in weather, etc. For example, a burn off operation may remove ground fuels, but may leave crown fuels behind. As well, on big fires, burning off is often only



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

occurring in certain areas. A more realistic and common goal is to **obtain better control of the fire by strengthening and widening the control line.**

THE PRINCIPLE OF PARALLEL ATTACK

We were introduced to **parallel attack** in the Fundamentals of Fire Fighting chapter. The **guiding principle of this method** is this: by removing any unburned fuels between the main fire and the guard, the **fuel side of the fire triangle will be eliminated**. As a result, the fire will either have nothing left to burn, or the control line will have been strengthened through the creation of a wider **fuel-free strip** with which to better secure and control the fire.

The control line is the critical component in any burning operation, and its role changes when we move from direct to parallel (or indirect) attack.

Consider this. Parallel attack does not allow us to establish and use a control line directly adjacent to the fire edge due to substantial fire behaviour (rank 3 +). If using hand guard, it will only be two feet wide at best. Do you think there is any chance it will stop a fast moving fire? The answer is no. Even dozer line 30 feet wide will not stop a fast moving fire. Whenever direct attack on a fire is not possible, burning off must be employed. **The control line in itself is not secure and must be reinforced** by building our guard as close to the fire as possible, and then using the principle of parallel attack to deprive the oncoming fire of fuel.

This **fuel-free strip** created by the burning off process now becomes the expanded control line that secures the fire. Establishment of the control line will be discussed in greater detail in the burning procedures section.

ENVIRONMENTAL CONDITIONS

Although the goal is to suppress the fire, we must first light one – we are literally fighting fire with fire! To be able to employ the principle of parallel attack by igniting our own fire, certain environmental conditions must be considered: **weather, terrain, fuel loading and potential fire behaviour.**

Weather

As with most fire operations, **wind and its direction** is by far the most influential weather factor when burning off. When lighting up, prevailing winds must be blowing towards the main burn and away from your control lines. Wind speeds must be moderate to light to give burn off crews some type of control in the operation. Fire will often create **convection** currents



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

as it draws oxygen from the atmosphere (discussed in the backfiring section). This will be advantageous to use when burning off, especially on larger fires. **If winds are not favourable, do not light!**

Temperature and **humidity** also are keys to success. If these conditions are not in order, burning will either be very difficult or cause control problems. High humidity and low temperatures make ignition difficult, which will result in a spotty burn that covers little ground. Conversely, high temperatures and low humidity will cause things to get out of control in a hurry. Any change in wind direction at this point may quickly compromise your control lines. Fire brands and embers blown across the line can turn into spot fires in short order. A happy medium is needed. **Temperature and humidity must be in a zone where ignition comes easy and all fuel is consumed at a manageable rate.**

Precipitation is self explanatory. If it rains, burning off becomes futile. Large operations and prescribed burns often plan the final stages of the burn to coincide with an expected rain event to help provide final control.

Terrain

The landscape must also be taken into account when burning off. Slope, terrain features, and aspect will all influence burning conditions. **It is advisable to always be lighting along control lines where the fire is upslope.** The fire will naturally travel upwards despite subtle wind shifts, and will be more readily drawn into the main fire.

Burning off when the fire is down slope or even side slope is difficult, and care must be taken so that excessive intensity is not created at or near your control lines. Only once a buffer of burnt fuel is established can more area can be involved at once. This method is more common during **prescribed burning operations** when there is no main fire, and requires a comprehensive and thorough plan.

Some fires will be flat with little terrain variations. It is very important to pay attention to the weather in these situations, as favourable winds are required before lighting.

Topographical features will greatly influence this operation also. Gullies, chutes and valleys will funnel fire. They will create greater intensity within them and therefore must be taken into consideration.

Fuel and Fuel Loading

Fuels are another consideration when planning a burn off, and again a happy



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

medium is best. They have to light and want to burn, but can't be so volatile that the burn can't be controlled. There must be enough fuel to keep the burn going, but not too much to make it unmanageable. Proximity of heavy fuel loading near control lines can offer some difficulties, and must be managed as part of the burn plan; ensuring proper placement of fuels when establishing control lines will help with this. The type of fuel will also play a major factor. For example, beetle killed forests will react much differently than a mixed stand of conifers and deciduous.

Potential Fire Behaviour

Once all these other factors have been measured, the final consideration is **potential fire behaviour**. If we introduce fire to the landscape, we need to know to the best of our ability what is going to happen. For this reason, it is customary to do small **test burns** before getting involved in the large scale operations. If these tests do not yield the desired results, then the bigger operation is postponed. There is always some risk involved in burning off, and sometimes that risk is greater when fire is encroaching on civilization. It is imperative all things have been considered before going ahead.



As you may have noticed, there is a great deal to consider when burning, most of which is outside of your scope. Fortunately, there are many experienced and qualified people who will make these key decisions. As a ground crew member, you may be called upon to provide important feedback to the fire management staff. Your knowledge will help immensely in the successful management of the operation!!

RESOURCES AND EQUIPMENT

Adequate and appropriate **resources and equipment** must be available during burning off operations.

Resources are split into two categories: **air and ground**.

CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

AIR RESOURCES

Utilizing aircraft is imperative to the success of burning off. Helicopters are used extensively, and play three primary roles:

Burning: Used to light-up using a heli-torch or AID machine. Often used in conjunction with ground crew lighting to widen control line and help draw the fire into the main burn.

Control: Medium (Type II) machines are used to bucket on any escapes or areas of concern. They will also be used to wet down fuels outside the guard.

Management: There will almost always be a machine utilized by the operational supervisor(s) to oversee the whole production to ensure things are going as planned, and that the safety of the ground crews is not being compromised.



GROUND RESOURCES

Ground resources consist of **crews, machinery, and equipment**. There needs to be enough of each to be successful. Crews must have enough personnel to dedicate to each facet of the operation described in the next section. Machinery must be clear of potential hazards but available to assist in containing escapes. **All equipment must be operational** and tested before burning off commences. For example, there must be enough ignition equipment (drip torches, fuel, etc.) to complete the intended objectives. The entire water delivery system to be employed must also be tested and fully functional.



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

Equipment used is specific to complete a burn off operations. The primary tools used for burning off in BC are the drip torch and the heli-torch.

DRIP TORCH

- **The most versatile and dependable of all burning tools.** It drops burning fuel directly onto the forest floor.
- Uses a mixture of readily available **diesel fuel and gasoline** in a 5:1 ratio, although variations in mixture ratios may be encountered (more diesel fuel makes the torch difficult to light, while more gasoline reduces duration of flame deposited and increases danger to user).
- A full tank of fuel will normally last for an hour or more, depending upon vent setting.



Set up

- Unscrew tank lock ring
- Change plug to open position
- Remove and invert spout
- Refasten ring



Lighting Procedure

- Open air vent.
- Invert torch, soaking ignition pad (wick)
- Ignite wick (always carry a lighter!!!)
- Return torch to vertical position
- Wick will continue to burn, and torch is ready for use.
- Adjust air vent to desired flow



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

Use on the Line

- Do not use the torch if there is evidence of any leaks or escapes of fuel from any point other than the wand.
- Make sure the flow of fuel is constant and unimpeded.
- Invert the torch, hold it slightly away from the body, and move off.
- Always pour fuel on the uphill side.
- Leave behind a string of fire at a speed that will depend on forest fuel conditions and topography. If ground fuels are damp, progress may be relatively slow; if they are dry, it is often possible to leave a continuous line of fires at a brisk walking pace.
- Ensure no large patches of ground fuels are left unburned.
- When stopped, one should conserve fuel and extinguish the torch.
- To extinguish the torch, place torch in upright position, close valve, blow out wick flame.

Safety During Use:

- Always wear gloves and make sure sleeves are rolled down
- Avoid fuel spills on clothing or body;
- Refuel well away from fire or embers;
- Tighten all connections well before using the torch;
- Keep wand pointed away from the body;
- Maintain balance and sure footing;
- Place torch in upright position when not in use for burning;
- Wipe off torch body and store well away from heat sources when not in use on the fireline;
- Keep eyes on other members of the crew and maintain a safe working distance.

HELI-TORCH



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

- A king-sized version of hand-held drip torch, slung beneath the helicopter with electrical circuitry to allow remote control by the pilot.
- Uses a special fuel product: “Petro-gel,” or the newer “Flash-21.” A diesel : fuel mix like that used in the drip torch can be used as well.
- Fuel reservoir (usually a 45-gallon drum), valve assemblies and ignition circuitry are mounted on a steel or aluminum framework slung beneath the helicopter.
- Ignition patterns similar to those of hand-held torches, although **volume of fuel deposited and the area covered are increased.**

OTHER IGNITION DEVICES

There are other ignition devices that you may encounter. They are less common or are used for a specific purpose.

Fusees

- Common railway / road flares producing **high heat intensity** for 10 - 20 minutes, depending upon type.
- Readily transportable, but inefficient as stand-alone ignition tool as flaming end must be applied directly to ground fuels until they ignite.
- Often thrown over line ignited by drip torch to **help increase heat and initiate convection.**
- Spike on end allows use of pole to extend reach and coverage.



Ignition Procedure

CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

- Remove taped-on safety cap, exposing primer and striker.
- Hold fusee with primer end pointing away from the body, and pass striker sharply cross the primer in a direction away from the body.
- Keep wind at back and avoid inhalation of sulfur fumes and possibility of burns from hot slag when the fusee ignites.

Aerial Ignition Device (Plastic Sphere Dispenser)

- High impact 32mm polystyrene “ping-pong” balls containing potassium permanganate are injected with ethylene glycol to cause ignition through chemical reaction.
 - Balls are delivered by a compact machine. It operates from the helicopters' electrical system, and when activated during flight it automatically injects the balls and dispenses them beneath the aircraft.
- 
- The image shows a person in a dark jacket and pants standing next to a helicopter. They are operating a machine mounted on the side of the helicopter, which is the Plastic Sphere Dispenser (PSD). The machine has a red handle and a hopper for the balls. The person is holding the handle, likely to activate the machine. The helicopter is white with a red stripe. The background shows a wooded area.
- Ignition by chemical reaction takes place in approximately one minute after injection. The ball burns for two minutes or more after ignition.
 - **The PSD machine does just that – it is a useful tool that “aids” by manipulating the ignited line.** It is usually used by dropping balls in between the burn line and the main fire. This will create more heat and help to “pull” the burn more easily into the main fire via **convection**. More on convection later.

PREPARING TO BURN

Before the burning operation itself is initiated, there are a variety of steps to first take in preparation. **Preparing an area to burn** according to a well designed plan is critical to success, and as much time is spent in this stage as in the burn itself. Well before the first match is lit, the following operational components must be established:

- LACES;
- Resource organization and briefing;
- Control lines;

CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

- Water delivery system;

LACES

Once again, safety is the most important consideration on the fireline, and burning operations are no exception. Lookouts, anchor points, communications, escape routes, and safety zones must all be established before the operation can progress.

Lookouts need to be posted before burning off commences. This can be done by placing someone at a key vantage point, or by using a helicopter as an “eye in the sky”.

Anchor Points are places where crews can safely and securely commence the burn off operation. They are the points along the control line logically chosen in which crews can “anchor in” and have the best chance at success. An example would be where the fireline meets an escape route downslope of the fire.

Communications are always established on any fire to ensure the safety of personnel. All crews will know the communication plan, and will be made aware of operational highlights such as light up, fire behaviour updates, etc. Communications are also essential in the event that a tactical withdrawal must be made. Aside from safety, communications are critical to the overall success of the operation by making sure that information and feedback is shared in order to make ongoing decisions.

Escape Routes are essential to all fire suppression activity, and are particularly important during burn off operations. Any time we add more fire to the landscape it increases the risk. As a standard, there must be two routes identified and tested.

Safety Zones are planned locations where fireline personnel can move to and be 100% safe from danger. Escape routes will lead to these zones, and will be communicated to all ground crews.

Resource Organization and Briefing

Resources must be organized and understand what exactly is going to happen. Crews will never be sent blindly into a situation; this will only decrease the chance for success and increase the potential for disaster. **Ground crews will be briefed thoroughly on the operation to ensure it is done safely and that they understand their particular role in the operation.** The crew leader will take an active role in ensuring the burn off in their area is going well and be cognizant of potential danger. If safety becomes compromised at any point, operations must cease and crews will take appropriate measures.



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

Control Lines

Although initial control lines are not designed to stop a fast moving fire, they are still **imperative to burning operations**. We have to be able to start from somewhere. **Control lines provide safe starting points** from where we can begin burning off and set the parameters for burning on our own terms.

For example: Hand guard is the least effective and most labour intensive means of constructing a control line. There are times, however, when terrain dictates that this is the only option. The guard will not necessarily stop a fast moving fire itself, but it *will* act as an excellent point from which to burn off. By “anchoring in”, we will be able to introduce fire at the rate and intensity we want: we are manipulating the conditions that are favourable to us. As a result, we can control the fire to a certain degree. Once the burning progresses and the hand guard is reinforced, it is just as effective as any other artificial control line.

Water Delivery

Once control lines are in place, they must be supported with a water delivery system which can service the entire length of line intended to be ignited. This is done before any burning begins, and **the line must be tested and fail safe**. The most experienced pump operators will be responsible for keeping water flow constant. The number of personnel will be determined by the distance the water needs to travel to get to the fireline and the number of pumps in the line. If the water delivery system fails at the wrong time, there is a possibility that the burn off will fail.

THE BURNING OFF OPERATION

When the conditions are right and all the above preparations are in place, all that is left to do is begin burn off operations. Although there are different tactics for different conditions, the general process of lighting is the same. **Ground crews will be given an objective to achieve**. Crews will then configure themselves to meet these objectives and mitigate the risk of crew safety and the fire escaping. Once again, the scale of the operation is a major determining factor in how many personnel will be need to get the job done.



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

GROUND CREW ROLES

Burn Off Supervisor

As with any fireline operation, there must be someone to direct, monitor, and oversee the task at hand. The burn off supervisor is responsible for the safety of everyone on the ground. He / she must make sure that everyone is aware of what is happening at all times. The supervisor will make decisions based on information he / she is receiving from the operation with the underlying theme that **crew safety is the most important concern**.

Nozzle Crew

Once the hose lay is in place, a designated crew will work to wet down the **outside of the guard** to increase humidity levels. This will protect loaded fuels and is done well in advance of lighting up. These crew members will be spread out, strategically located and **dedicated to this task throughout the entire operation**. They will also act as spark chasers in the event that fire finds its way to the wrong side of the line. They are in position and ready to act quickly. The number of people needed for this will vary; there must be enough to visually cover the entire length of the line being addressed.



Burn Off Crew

There will be as many as five or as few as one person actually burning off. This again is **determined by the burn objectives** in relation to ground to cover, terrain, and fire behaviour. If there is a large amount of fuel between the main fire and the control line, it is more efficient to use more torches and vice versa. A heli-torch may do the bulk of the work deeper inside the control lines with ground crews working adjacent to control lines that require more finesse. There is no



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

rule of thumb for this. What will work best in the situation is determined on a case to case basis from on site observations at that moment.

Mixing Crew

This job is not always performed by BCFS crews. However, if there are enough people on the line to adequately fill all the roles above, crews may also be called upon to mix the fuel for the **heli-torch**. As with drip torches, heli-torch fuels must be mixed at a certain ratio. Although they can use a diesel:gas mix, they usually use the specialized products of either “Petro-gel” or the newer “Flash-21.” Both products are very toxic, and **to be handled safely personnel must wear the proper PPE and adhere to specific procedures.**



CREW FORMATION

The formation of the burn off crew is strict and organized. To avoid entrapment, the first lighter should be closest to the main fire with successive lighters staggered progressively closer to the fireline. Successive lighters must allow the previous to be a safe distance ahead or they may be entrapped by fire. **Teamwork and verbal communication between these individuals is paramount**, especially when dense bush makes visibility difficult. The distance between each torch will be determined by fire behaviour and overall objectives.



Controlling the burn

Staying in control of the operation is critical and is possible by manipulating the amount of



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

fire intensity created. A primary method used when lighting is to **maintain the lines at a certain width**. The tighter they are together, the less momentum of the fire. Conversely, momentum is increased by widening the lines. Projected vigour of the burn will depend on the situation and objectives, with the decisions being made by operational supervisors.

A NOTE ABOUT PRESCRIBED BURNING

In an effort to avoid confusion, it needs to be noted that lighting procedures and crew formation is slightly different during prescribed burning.

Consider this: Burning off is an operation with the objective of getting rid of fuels in between a control line and an approaching fire. As we have learned, we want to manage our burn by allowing it to be drawn towards the main fire in a controlled environment. Correct? This is why burning off operations are usually initiated at the bottom of a slope so that the fire will easily move upslope into the approaching fire.

With prescribed burning, the conditions are changed: we don't have a fast approaching fire! Therefore, we most definitely do not want to start the fire at the bottom of a slope. Without another fire for it to be drawn into, our "burn" would race up the hill and we would soon have our own fast moving and uncontrolled fire heading towards Merritt to contend with!

Instead, we will be lighting at the top of the slope, and will steadily work backwards until the entire area has been burned off. We will control the fire by keeping our lines relatively tight – if we don't and conditions allow it, there is the potential for the fire to gain momentum and jump the guard.

With this will also come a change in crew formation. Instead of lighting strips and working back towards the guard, we will be starting adjacent to the guard and basically staggering ourselves reversely.



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

BURNING OUT, BURNING OFF AND BACKFIRING

When fire behaviour is beyond normal means of control and there is imminent danger to life and property, a last alternative may be employed. This is known as **backfiring**. **Backfiring is rare in BC, and is essentially the same as burning out but on a much larger scale.**

*****Experienced personnel, available time and suitable terrain are the critical factors in the successful application of this method*****

GOALS

The goal of this method is the same as burning off: remove the available fuels to burn. Where it differs is the **scope** of the execution. **Burning out and backfiring aims to deprive the fire front of as much fuel as possible in as short a time as possible.** This will hopefully reduce momentum and allow attacking forces time to complete an adequate control line.

THE PRINCIPLE OF INDIRECT ATTACK

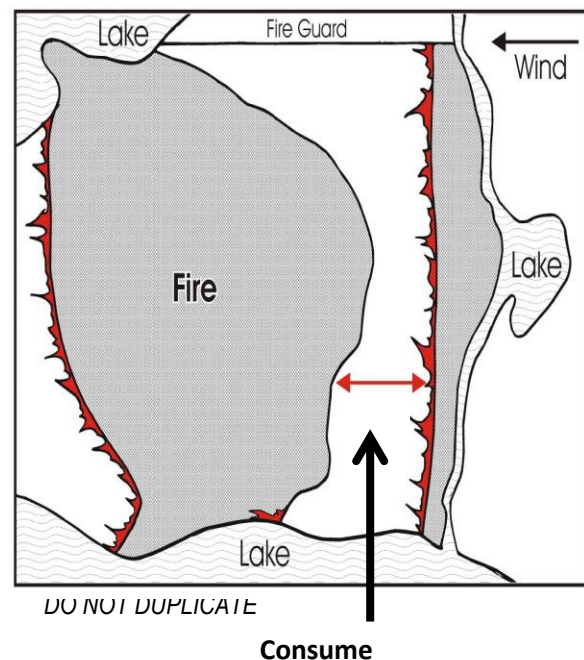
The principle of indirect attack is similar to parallel attack; control the fire by removing the fuel side of the fire triangle. Again where it differs is in the **scope** of the operation. **The control line is established well ahead of the main fire**, taking advantage of favourable terrain and natural breaks to reduce construction time. When a line is established, the intervening fuel is burned off in as wide a strip as possible before the main fire front arrives.

Burning Out

Burning out is a fire suppression operation where fire is set along the inside edge of a control line or natural barrier to consume unburned fuel between the control line and fire perimeter, thereby reinforcing the existing line and speeding up the control effort.

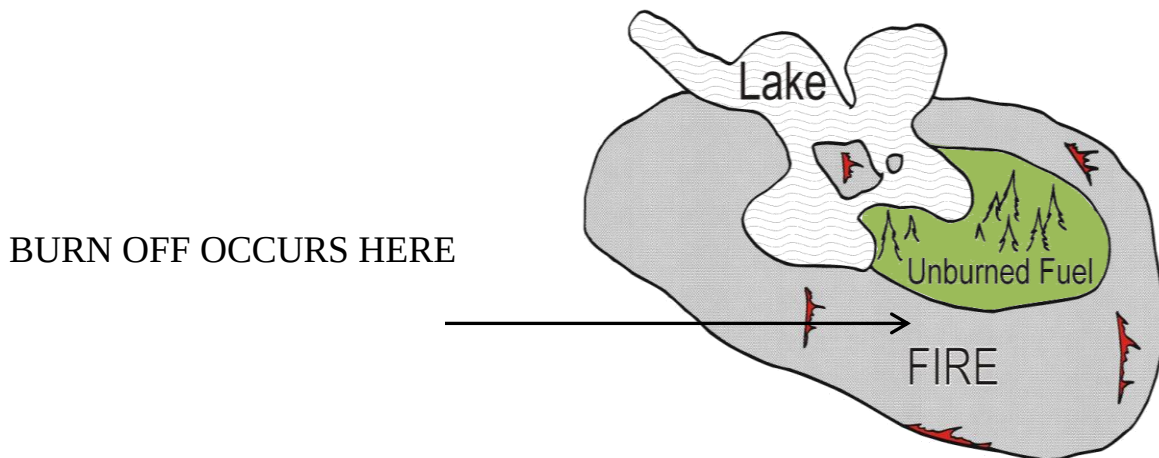
With indirect attack, a control line is strategically located **away from the fire's edge** to take advantage of favourable terrain and natural fuel-breaks in advance of the fire perimeter.

A constructed control line in an indirect attack is not designed to and will not stop a moving fire. The control line is meant to serve as a base line from which burning out fires can be set and controlled. Control line construction for indirect attack is covered in the units on Constructing Control Line Using Hand



Burning Off

Burning off is a fire suppression operation where fire is set to **consume islands of unburned fuel inside the fire perimeter**. This eliminates the potential of re-ignition and spread.

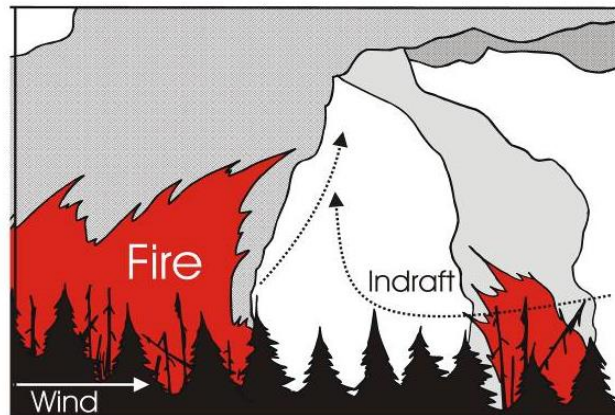


CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

Backfiring

Backfiring is a form of indirect attack where extensive fire is **set ahead of the main fire** but close enough to the head of the fire to **take advantage of indrafts (convection)** from the main fire. The objective of a backfiring operation is to consume fuels in the path of the fire and thereby halt, retard or steer the progress of the fire front.

Although the majority of backfires are lit aerially by helicopters outfitted with ignition devices, there are situations in which fire crews are used to light in certain areas. Whatever the case, only highly experienced, certified fire control personnel will be in charge. Attention to safety is especially critical during backfiring when crews are positioned in front of the head of the fire. Special plans must be in place for quick evacuation of crews in the event of problems with the operation.

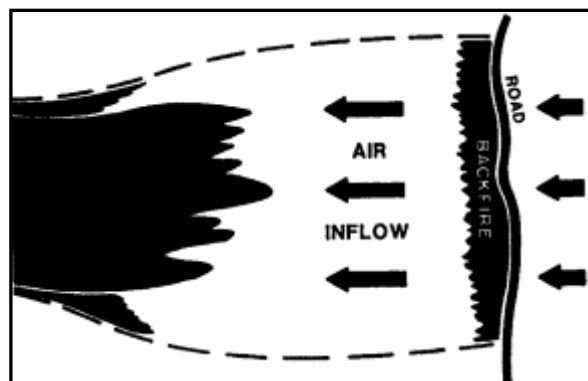


THE BASIC APPROACHES

Ignition operations can be considered under the following two broad headings

Classic Indirect

- The most common application, known simply as **indirect attack**.
- **Used when a large and significant control line is available** some distance ahead of the fire, or when there is



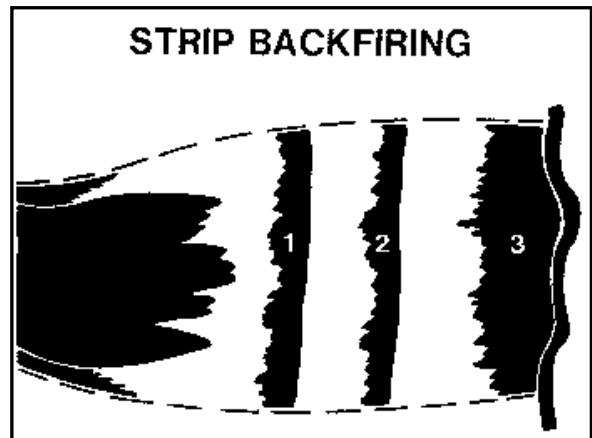
CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

sufficient time for available resources to construct a line in time.

- **Process:** Once said control line is secured across the head and connected along the flanks, the intervening fuel is then burned off in **one fell sweep**.
- The burn is lit at the control line in as wide a strip as possible until the backfire is met by the advancing main fire front.

Strip Backfiring

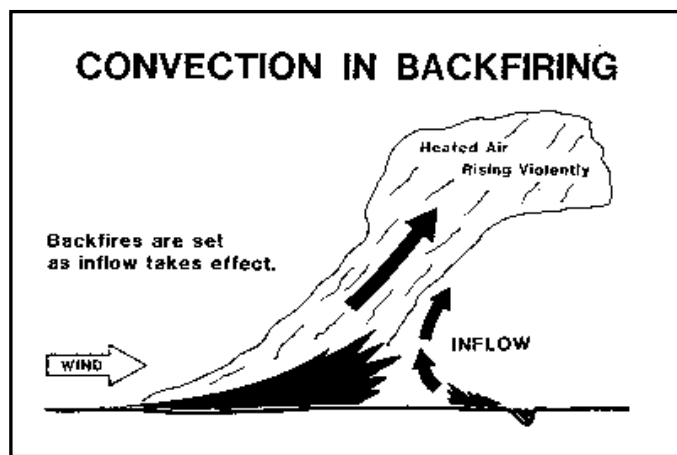
- **Used when control lines are not available**, circumstances and terrain are unfavourable, and / or the fire is moving fast under severe burning conditions. A critical situation that calls for desperate measures to establish control.
- **Process:** Line is quickly prepared and, at the right moment, the first backfire is lit nearest to the main fire. **Convection** draws the line into the main fire, eliminating fuels. Other backfires are then subsequently lit until the fire approaches the control line that is now hopefully better established.



CONVECTION

Convection is utilized in burning off operations as well as backfiring; however, it is discussed here in detail as it is ever that more **critical** in a **backfiring operation**. Timing is

DO NOT DUPLICATE



CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

everything: determining when the inflow or draught from the main fire begins to take effect is critical. Once this air flow becomes apparent, a line of fire is set out across the head of the main fire. This line of fire should join into a solid wall to be drawn into the main fire, consuming the intervening fuel. **This pulling, or drawing, action of cool air into the fire is known as convection.**

In order to use the elements of convection to execute a successful burning operation, **topography, fire size and rate of spread, and timing** all need to be considered:

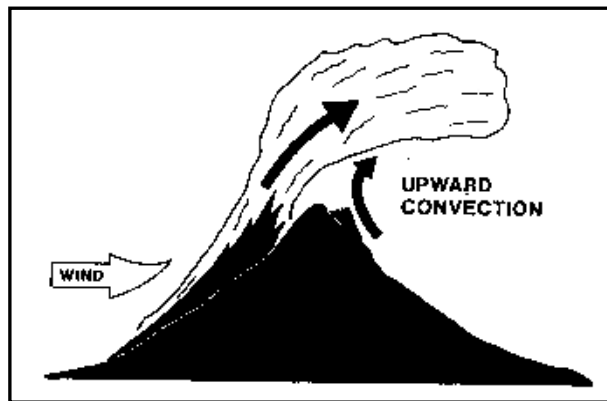
Topography

The lay of the land will help to determine when the timing is right to light a back fire.

- Fires will be driven primarily by wind and slope / terrain features.
- As heat rises, cooler “replacement” air is supplied from the rear and flanks of the fire. This intake of air creates the inflow, or draught, that causes convection forces. Once the inflow is apparent, it can be used to control backfires.

Approaching A Crest

- As the fire approaches the top, air is drawn UP from the other side of the hill; this will provide the opportunity to set a backfire.
- Control lines are established on the opposite side of the slope, and the backfire is set from there.



Fire Size and Rate of Speed

These two factors are key in deciding the **distance ahead and placement of the backfire**. They will also give an indication of the overall difficulty of control. The larger the fire and the faster the rate of spread, the more critical, and difficult, the backfiring operation becomes. Sufficient time must be allowed to find or create a suitable control line.

CHAPTER 4 BURNING OUT, BURNING OFF AND BACKFIRING

Timing

In terms of backfiring, **timing is everything**. It takes an experienced hand to drop the match at just the right time to make the operation successful. It also takes a requisite amount of time to set up properly. Once prepared and before ignition takes place, the inflow winds or convection from the main fire must be present.

Although the majority of backfires are lit aerially by helicopters, crews will still be used to light in certain areas. Whatever the case, only highly experienced, certified fire control personnel will be in charge. Crews must pay particular attention to safety during backfiring as they are positioned in front of the head of the fire. Special plans must be in place for quick removal of crews in the event the operation. Rest assured this is an uncommon operation and is done only in a last resort!!!