Summary:
Firing can often be a very complex or intuitive tactic to implement. This unit is intended to introduce the basic firing devices and principles used for firing operations.

Incident Position Description (IPD) Alignment:
This unit aligns with the following FFT2 IPD specific duties (https://www.nwcg.gov/positions/fft2/position-ipd):

- Perform wildland fire and prescribed fire duties including suppression, preparation, ignition, monitoring, holding, and mopup.
- Use standard firefighting tools such as pulaskis, shovels, McLeods, chainsaws, drip torches, and fusees.
- Provide for health, safety, and welfare for self and those around you.

Objectives:
Students will be able to:

- Identify commonly used firing devices.
- Describe situations where the use of firing devices may be used.
- Discuss advantages and disadvantages of the different firing devices.
- Describe hazards associated with use of common firing devices.
- Demonstrate safe use and storage of firing devices.
- Identify alternative devices for igniting fuels.
Unit at a Glance:

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Materials:

- The tools and equipment presented in the unit, as well as local area specific tools and equipment.
- Required fireline PPE.
- Notebook for participants.
- S-130 Student Evaluation Task Sheet.
- Ability to display images and video on large screen (if field presentation not possible).
- White board or easel access for group breakout (if field presentation not possible).
Note to Instructor

- This unit is intended to be taught as a hands-on presentation in the field.
- The tools and equipment referenced should be available as props for instructors and hands on implements for students.
- If field presentation is not possible, the unit can be taught via the PowerPoint in a classroom, utilizing the tools and equipment as reference.
Objectives

Students will be able to:

• Identify commonly used firing devices.

• Describe situations where the use of firing devices may be used.

• Discuss the advantages and disadvantages of the different firing devices.

Review unit objectives.
Objectives

Students will be able to:

- Describe hazards associated with use of common firing devices.
- Demonstrate safe use and storage of firing devices.
- Identify alternative devices for igniting fuels.

Review unit objectives.
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Firing Device PPE

- Discuss required PPE:
  - Hardhat.
  - Flame resistant pants.
  - Flame resistant shirt, sleeves rolled down.
  - Leather gloves.
  - Approved boots.
  - Eye protection.
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Common Devices

Drip Torch

- Discuss the drip torch and its use:
  - A handheld device used for igniting fires in any fuel type.
  - Drips flaming liquid fuel on the materials to be burned.
  - Fuel used is generally a mixture of diesel and gasoline at a ratio of 4 parts Diesel fuel and 1-part gasoline.
  - Common in areas with limited access.
  - For burning small areas where hand ignition is the preferred method.
  - For burning out along control lines.

- Discuss advantages:
  - Inexpensive, easy to use, and portable.
  - Suitable for terrain where other ground ignition equipment cannot be used.
  - Requires little setup time.
  - Effective in most fuel types.

- Discuss disadvantages:
  - Exposes the operator to the flammable gas/diesel mixture.
  - Require a larger crew working longer to complete a burn (increasing the exposure to hazards during burning) when compared to other forms of ground ignition.
  - Can become tiring to carry.
  - Having the ability to re-fuel the torch may be difficult depending on the location of the fuel supply.
  - A lot of times lighters will choose to carry two torches depending on how far they progress from a refueling source and how remote the terrain may be.
Discuss parts of the drip torch fully assembled for operation:

- Igniter (wick).
- Nozzle and nozzle bore.
- Discharge spout.
- Vent cap and breather tube.
- Handle.
- Tank cover lock ring (gasket location).
- Tank.
Discuss drip torch spout components:

- Tank cover.
- Discharge plug.
- Discharge plug (parked) when fuel outlet is open for flow.
- Discharge plug (transport position) when fuel outlet is plugged.
Discuss additional recommended PPE, specific to drip torch use:
- Over the calf, wool blended socks.
- Full water bottle or small fire extinguisher (in case fuel ignites on clothing).
- Nomex neck and face shroud.

Discuss the responsibility of an operator to implement safety or emergency procedures related to drip torch use:
- Clothing catching on fire.
- Replacing fuel-soaked clothing as soon as possible.
- Burning fuel is on clothing.
- Torch catching on fire.
- Handling a major fuel spill (more than 5 gallons).
Discuss the steps taken when mixing fuel.

Discuss how to refuel a torch during operations.

Reference *NWCG Standards for Ground Ignition Equipment*, PMS 443,

- Burn mix ratio may vary depending on fuel type, load, moisture and time of year, RH, and temperature. *NWCG Standards for Ground Ignition Equipment* generally recommends a 4:1 ratio for drip torches.
Common Devices

Drip Torch - Operation

- Demonstrate the steps to prepare a drip torch for use.
- Demonstrate the steps required to ignite the torch.
- Demonstrate the procedures for using the drip torch.
- Demonstrate how to extinguish the torch.
- Demonstrate how to prepare the torch for transportation and storage after operations.
Describe functional issues a drip torch may have and how to fix them if possible:

- Tank cover leaks:
  - Make sure that the lock ring is tight.
  - Make sure that the gasket is not missing, damaged, or defective
- Advise participants that burn injuries have occurred due to lock rings detaching from a full drip torch:
  - Potential exist due to lock ring and drip torch tank being from different manufactures or a result of common wear.
  - Ensure that lock ring engages thread for at least 1-1/2 full turns.
  - Any less than 1-1/2 full turns may indicate inadequate thread engagement and lead to possible detachment.
  - If lock ring becomes tight with less than one full turn, assume that the components are mismatched as a result of different manufactures; do not use.

Note to Instructor

Additional information regarding this issue is also available through the Wildland Fire Lessons Learned Center, Clear Creek RX Drip Torch Leg Burn (2021): https://www.wildfirelessons.net/orphans/viewincident?DocumentKey=bea5d059-3437-4fb3-a7c6-5f4a321a3574etc-sa-2021-01.pdf .

Consider providing participants with a copy of one or both of these incident summary documents.

- Fuel does not pour from torch:
  - Make sure that you have removed the discharge closure plug.
Unit 11: Firing Devices

- Check for an obstruction in the fuel spout.
- Make sure the breather valve is open and unobstructed.

• Torch is difficult to light:
  - Make sure that the wick is saturated with fuel.
  - Wick may need replaced.
  - Check the fuel mixture it may have too much diesel.
  - Fuel Burns up Before Reaching the Vegetation:
    - Check the fuel mixture it may have too much gasoline.

☐ Describe steps to make sure the drip torch is in working order for the next use:
  - Cleaning and repair:
    - Note any leakage.
    - Clean the drip torch as recommended by the manufacturer.
    - Tag damaged parts.
    - Replace any defective seals or other damaged parts.

☐ Discuss storing the torch and fuel:
  - Fuel should be stored only in drip torches that meet DOT specifications.
  - All standard drip torches, whether full or empty, should be stored with the:
    - Fuel spout and wick assembly stowed inside the fuel tank (does not apply to the Panama torch, used in some geographic areas, due to the length of the spout).
    - Lock ring hand tightened.
    - Closure plug installed and hand tightened.
    - Breather valve closed.
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Common Devices

- Discuss fusees and their use:
  - Handheld disposable ground ignition device with a self-contained ignition system widely used to ignite backfires and other prescribed fires.
  - Used when burning grass, pine needles, leaves, brush, and similar dry fuels that ignite readily and radiate enough heat to sustain combustion.
  - Used to create emergency safety zones.

- Discuss Advantages:
  - Obtainable from most fire caches.
  - Inexpensive, easy to use, portable.
  - Effective in all continuous fuel types.
  - Lightweight and have a weather resistant wax coating.
  - Used from a utility vehicle or while walking.
  - Used to light other ignition devices.
  - Carried in fireline packs.
  - Burn up to 10 minutes.
  - Can be connected to other fusees or a stick to keep the burning fusee away from your body.
  - Safe and stable to store, require little storage space.

- Discuss Disadvantages:
  - Not effective in wet or non-continuous fuels.
  - Will not function if the fusee becomes wet.
  - Cannot be transported on airlines.
Unit 11: Firing Devices

- Special transportation requirements exist for hazardous material, fusees require disclosure to helicopter pilots if transported in helicopters.
- Burn at temperatures higher than 1,400 °F.
- Emit noxious fumes.
- Drip and splatter molten material that can burn through protective clothing.
- Hard to extinguish once they are ignited but may extinguish when thrown if they are not fully burning.
Describe the components of a fusee and their functions:

- Ferrule.
- Body.
- Protective striker cap.
- Striker cap tape.
- Wax coating.
Describe the components of a fusee and their function:

- Scratch tip.
- Striker compound.
- Striker cap.
Demonstrate how to ignite and operate a fusee.
Discuss fusee safety precautions and requirements.
Discuss method for extinguishing fusee.
Explain the purpose of a hand-launched flare and situations where it would be used:

- Increase depth by providing enough heat and fire behavior to manipulate the fire's intensity.
- Influence spread direction on or near the control line by causing the backfire to pull deeper into the main fire.

Explain that hand-launched flares work best when:

- Burning grass, pine needles, leaves, brush, and similar dry fuels will ignite readily and radiate enough heat to sustain combustion.
- Fuse time delay (20 to 30 seconds) allows for safe short-distance throwing of flare.
Discuss that unlike the drip torch or fusee, a FFT2 does not commonly operate this device until they have gained more experience in fire behavior and launcher operation; however, it is a tool that they may encounter being used during firing operations.

Discuss the use of hearing protection as additional required PPE.

Discuss the purpose of the flare launcher:
- Create depth.
- Increase heat and fire behavior.
- Manipulate spread direction on or near the control line during burnout and backfiring operations causing the backfire to pull deeper into the main body of the fire.

Discuss that flares and flare launchers work best when:
- Burning dry, light, continuous ground fuels.
- Igniting fuels at a greater distance, across a water barrier, or in terrain that is steep, hazardous, or inaccessible.
- Igniting fuels to draw flames away from the fireline.

Discuss advantages:
- Easy to obtain.
- Lightweight and compact.
- Allow remote ignition in steep or inaccessible terrain.
- Easy to use and operate with minimum training.
- Allow firefighters to ignite fuels quickly while minimizing exposure in hazardous terrain.

Discuss disadvantages:
- Some launchers are not designed for repeated firing.
Unit 11: Firing Devices

- Firing pins bend on some brands.
- Frames may develop cracks.
- Very loud, can cause hearing damage if hearing protection is not worn.
- Flares for launchers can be costly.
Discuss how to properly care for, maintain, and store flare devices:

- Store in a clean, dry place at temperatures from 40 to 90 °F.
- Never store near an ignition source (such as sparks or flames).
- Keep away from oil and water and out of direct sunlight.
- Rotate the stock to keep a fresh supply.
- Do not stack heavy items on flares.
- When possible, store in the plastic bag or in the original box.
- If body is damaged, punctured, or worn, dispose of it.
Knowledge Check

Select the statement that depicts appropriate storage and maintenance of a fusee.

1. Always remove the cap before putting fusees in a pack to prepare for ignition.
2. Never store fusees near an ignition source.
3. Store fusees in the cab of a truck for easy access.
4. A fusee is still safe to use if it appears to be damaged.

Question: Select the statement that depicts appropriate storage and maintenance of a fusee.

*Answer: Never store fusees near an ignition source.*
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Alternative Devices

- Discuss alternative firing devices such as:
  - Terra Torch.
  - Propane torches.
  - Plastic sphere launchers (PyroShot launcher).
  - Sling shots.
  - Gel blivets.
  - Matches.

**Note to Instructor**
Discuss the purpose of a backfire:

- A fire set along the inner edge of a fireline to consume the fuel in the path of a wildfire or change the direction of force of the fire's convection column.
- Large scale burn.
- Used to limit impacts to values in the path of a large wildfire.
- Enhance the integrity of the control line when direct attack is not feasible due to extreme fire behavior.

- Reference the *NWCG Glossary of Wildland Fire*, PMS 205, [https://www.nwcg.gov/glossary/a-z](https://www.nwcg.gov/glossary/a-z).
Purpose of Firing Operations

Wildfire - Burn Out

- Discuss the purpose of a burn out:
  - Setting fire inside a control line to consume fuel between the edge of the fire and the control line.
  - Small scale burn.
  - Used for cleaning up pockets of unburned fuel and islands as well as maintaining a consistent black edge next to the control line, improving line integrity and safety.

- Reference the *NWCG Glossary of Wildland Fire*, PMS 205, [https://www.nwcg.gov/glossary/a-z](https://www.nwcg.gov/glossary/a-z).
Discuss jackpot burning and its purpose:

- Used to deliberately burn natural or modified concentrations (jackpots) of wildland fuels under specified environmental conditions, which allows the fire to be confined to a predetermined area and produces the fireline intensity and rate of spread required to attain planned resource management objectives.

- Reference the NWCG Glossary of Wildland Fire, PMS 205, [https://www.nwcg.gov/glossary/a-z](https://www.nwcg.gov/glossary/a-z).
Purpose of Firing Operations

Wildfire – Bone piling

- Discuss the purpose for bone piling:
  - Stacking burning 1,000-hour fuels interior of the control line where they can be fully consumed more rapidly.
  - Creates less mop up and reduces the potential for fire spread by spot fires due to blowing embers near the control line.
Discuss the purpose of using firing operations to protect values at risk:

- Pre-planned.
- Proactive and defensive tactics to reduce the impact a wildfire would normally have on specific values at risk.

Discuss values at risk protected by the use of firing operations:

- Life of fire personnel and civilians.
- Structures.
- Archeological and cultural sites.
- Critical wildlife habitat.
- Infrastructure.
Knowledge Check

What kind of firing operation, described below, requires firing devices?

A fire set along the inner edge of a fireline to consume the fuel in the path of a wildfire or change the direction of force of the fire's convection column.

Backfiring

Question: What kind of firing operation, described below, requires firing devices?

Answer: Backfiring
Discuss the purpose of pile burning:

- Slash piles are formed by the process of thinning to reduce threat of large fire growth and extreme fire behavior, as well as maintaining a specific fuel characteristic that is historical to the landscape.
- Slash piles can be formed by hand or mechanical thinning.
- Drip torches and fusees are the preferred ignition tool for this operation.
Describe broadcast burning and its purpose:

- Broadcast burning is a prescribed burning activity where fire is applied generally to most or all of an area within well-defined boundaries for reduction of fuel hazards, as a resource management treatment, or both.

Objectives

Students will be able to:

• Identify commonly used firing devices.

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• Discuss the advantages and disadvantages of the different firing devices.

- Review unit objectives.
Objectives

Students will be able to:

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