

**Introduction to Wildland Fire Behavior (S-190)
Resources**

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Web Resources

Fireline Handbook

<http://www.nwcg.gov/pms/pubs/410-1/410-1.pdf>

Incident Response Pocket Guide

<http://www.nwcg.gov/pms/pubs/nfes1077/nfes1077.pdf>



Incident Response Pocket Guide

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as a subset to PMS 410-1 Fireline Handbook

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Operational Leadership

The most essential element of successful wildland firefighting is competent and confident leadership. Leadership means providing purpose, direction and motivation for wildland firefighters working to accomplish difficult tasks under dangerous, stressful circumstances. In confusing and uncertain situations, a good operational leader will:

- **TAKE CHARGE** of assigned resources.
- **MOTIVATE** firefighters with a “can do safely” attitude.
- **DEMONSTRATE INITIATIVE** by taking action in the absence of orders.
- **COMMUNICATE** by giving specific instructions and asking for feedback.
- **SUPERVISE** at the scene of action.

D U T Y

Be proficient in your job, both technically and as a leader

- Take charge when in charge.
- Adhere to professional standard operating procedures.
- Develop a plan to accomplish given objectives.

Make sound and timely decisions

- Maintain situation awareness in order to anticipate needed actions.
- Develop contingencies and consider consequences.
- Improvise within the leader's intent to handle a rapidly changing environment.

Ensure that tasks are understood, supervised and accomplished

- Issue clear instructions.
- Observe and assess actions in progress without micro-managing.
- Use positive feedback to modify duties, tasks, and assignments when appropriate.

Develop your subordinates for the future

- Clearly state expectations.
- Delegate those tasks that you are not required to do personally.
- Consider individual skill levels and developmental needs when assigning tasks.

R E S P E C T

Know your subordinates and look out for their well-being

- Put the safety of your subordinates above all other objectives.
- Take care of your subordinate's needs.
- Resolve conflicts between individuals on the team.

Keep your subordinates informed

- Provide accurate and timely briefings.
- Give the reason (intent) for assignments and tasks.
- Make yourself available to answer questions at appropriate times.

Build the team

- Conduct frequent debriefings with the team to identify lessons learned.
- Recognize individual and team accomplishments and reward them appropriately.
- Apply disciplinary measures equally.

Employ your subordinates in accordance with their capabilities

- Observe human behavior as well as fire behavior.
- Provide early warning to subordinates of tasks they will be responsible for.
- Consider team experience, fatigue, and physical limitations when accepting assignments.

I N T E G R I T Y

Know yourself and seek improvement

- Know the strengths / weaknesses in your character and skill level.
- Ask questions of peers and superiors.
- Actively listen to feedback from subordinates.

Seek responsibility and accept responsibility for your actions

- Accept full responsibility for and correct poor team performance.
- Credit subordinates for good performance.
- Keep your superiors informed of your actions.

Set the example

- Share the hazards and hardships with your subordinates.
- Don't show discouragement when facing setbacks.
- Choose the difficult right over the easy wrong.

Communication Responsibilities

All firefighters have five communication responsibilities:

- Brief others as needed
- Debrief your actions
- Communicate hazards to others
- Acknowledge messages
- Ask if you don't know

In addition, all leaders of firefighters have the responsibility to provide complete briefings that include a clearly stated “Leaders Intent.”

- Task = What is to be done
- Purpose = Why it is to be done
- End State = How it should look when done

Human Factors Barriers to Situation Awareness and Decision-Making

Low Experience Level with Local Factors:

- Unfamiliar with the area or the organizational structure.

Distraction from Primary Duty:

- Radio traffic
- Conflict
- Previous errors
- Collateral duties
- Incident within an incident

Fatigue:

- Carbon Monoxide
- Dehydration
- Heat stress and poor fitness level can reduce resistance to fatigue.
- 24-hours awake affects your decision-making capability like .10 blood alcohol content.

Stress Reactions:

- Communication deteriorates or grows tense.
- Habitual or repetitive behaviors.
- Target fixation - locking into a course of action, whether it makes sense or not, just try harder.
- Action tunneling - focusing on small tasks but ignoring the big picture.
- Escalation of commitment – accepting increased risk as completion of task gets near.

Hazardous Attitudes:

- Invulnerable – That can't happen to us
- Anti-authority – Disregard of the team effort
- Impulsive – Do something even if it's wrong
- Macho – Trying to impress or prove something
- Complacent – Just another routine fire
- Resigned – We can't make a difference
- Group Think – Afraid to speak up or disagree

Risk Management Process

Step 1 Situation Awareness

Gather Information

- Objective(s) Previous Fire Behavior
- Communication Weather Forecast
- Who's in Charge Local Factors

Scout the Fire

Step 2 Hazard Assessment

Estimate Potential Fire Behavior Hazards

- Look Up/Down/Around Indicators

Identify Tactical Hazards

- Watch Outs

What other safety hazards exist?

Consider severity vs. probability?

Step 3 Hazard Control

Firefighting Orders → LCES Checklist - MANDATORY

- Anchor Point
- Downhill Checklist (if applicable)

What other controls are necessary?

Step 4 Decision Point

Are controls in place for identified hazards?

NO - Reassess situation YES - Next question

Are selected tactics based on expected fire behavior?

NO - Reassess situation YES - Next question

Have instructions been given and understood?

NO - Reassess situation YES - Initiate action

Step 5 Evaluate

Human Factors: Low experience level?
 Distracted from primary tasks?
 Fatigue or stress reaction?
 Hazardous attitude?

The Situation: What is changing?
 Are strategy and tactics working?

Look Up, Down and Around

(Pay special attention to indicators in bold print.)

Fire Environment Factors	Indicators
Fuel Characteristics Assess	Continuous fine fuels Heavy loading of dead and down Ladder fuels Tight crown spacing (<20 ft.) Special Conditions: Firebrand sources Numerous snags Preheated canopy Frost and bug kill Unusual fine fuels High dead to live ratio
Fuel Moisture Feel and Measure	Low RH (<25%) Low 10 hr FMC (<6%) Drought conditions Seasonal drying
Fuel Temperature Feel and Measure	High temps (>85F) High % of fuels w/direct sun Aspect fuel temp. increasing
Terrain Scout	Steep slopes (>50%) Chutes - Chimneys Box canyons Saddles Narrow canyons

Look Up, Down and Around

(Pay special attention to indicators in bold print.)

Fire Environment Factors	Indicators
Wind Observe	Surface winds above 10 mph Lenticular clouds High, fast-moving clouds Approaching cold fronts Cumulonimbus development Sudden calm Battling or shifting winds
Stability Observe	Good visibility Gusty winds and dust devils Cumulus clouds Castellatus clouds in the a.m. Smoke rises straight up Inversion beginning to lift Thermal belt
Fire Behavior Watch	Leaning column Sheared column Well-developed column Changing column Trees torching Smoldering fires picking up Small firewhirls beginning Frequent spot fires

Common Denominators of Fire Behavior on Tragedy Fires

There are four major common denominators of fire behavior on fatal and near-fatal fires. Such fires often occur:

1. On relatively small fires or deceptively quiet areas of large fires.
2. In relatively light fuels, such as grass, herbs, and light brush.
3. When there is an unexpected shift in wind direction or in wind speed.
4. When fire responds to topographic conditions and runs uphill.

Alignment of topography and wind during the burning period should always be considered a trigger point to re-evaluate strategy and tactics.

Tactical Watch Outs

Position

1. Building fireline downhill.
2. Building underslung or mid-slope fireline.
3. Building indirect fireline, or unburned fuel remains between you and the fire.
4. Attempting frontal assault on the fire, or you are delivered by aircraft to the top of the fire.
5. Terrain and/or fuels make escape to safety zones difficult.

Situation

6. Small fire emerging into a larger fire or an isolated area of a large fire.
7. Suppression resources are fatigued or inadequate.
8. Assignment or escape route depends on aircraft support.
9. Night-time operations.
10. Wildland-Urban interface operations.

Each of these Watch Outs require that you implement appropriate hazard control(s).

LCES Checklist

LCES must be established and known to
ALL firefighters **BEFORE** needed.

Lookout(s)

Experienced / Competent / Trusted
Enough lookouts at good vantage points
Knowledge of crew locations
Knowledge of escape and safety locations
Knowledge of trigger points
Map / Weather Kit / Watch / IAP

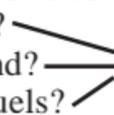
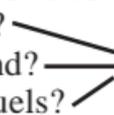
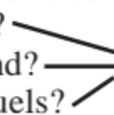
Communication(s)

Radio frequencies confirmed
Backup procedures and check-in times established
Provide updates on any situation change
Sound alarm early, not late

Escape Route(s)

More than one escape route
Avoid steep uphill escape routes
Scouted: Loose soils / Rocks / Vegetation
Timed: Slowest person / Fatigue & Temperature factors
Marked: Flagged for day or night
Evaluate: Escape time vs. Rate of spread
Vehicles parked for escape

Safety Zone(s)

Survivable without a fire shelter
Back into clean burn
Natural Features: Rock Areas / Water / Meadows
Constructed Sites: Clearcuts / Roads / Helispots
Scouted for size and hazards
Upslope? 
Downwind? 
Heavy Fuels? 
More heat impact → Larger safety zone

Escape time and safety zone size requirements
will change as fire behavior changes.

Safety Zone Guidelines

- Avoid locations that are downwind from the fire.
- Avoid locations that are in chimneys, saddles, or narrow canyons.
- Avoid locations that require a steep uphill escape route.
- Take advantage of heat barriers such as lee side of ridges, large rocks, or solid structures.
- Burn out safety zones prior to flame front approach.
- For radiant heat only, the distance separation between the firefighter and the flames must be at least four times the maximum flame height. This distance must be maintained on all sides, if the fire has ability to burn completely around the safety zone. **Convective heat from wind and/or terrain influences will increase this distance requirement.**

CALCULATIONS ASSUME NO SLOPE AND NO WIND

<u>Flame Height</u>	<u>Distance Separation (firefighters to flame)</u>	<u>Area in Acres</u>
10 ft.	40 ft.	1/10 acre
20 ft.	80 ft.	1/2 acre
50 ft.	200 ft.	3 acres
75 ft.	300 ft.	7 acres
100 ft.	400 ft.	12 acres
200 ft.	800 ft.	50 acres

Distance Separation is the radius from the center of the safety zone to the nearest fuels. When fuels are present that will allow the fire to burn on all sides of the safety zone this distance must be doubled in order maintain effective separation in front, to the sides, and behind the firefighters.

Area in Acres is calculated to allow for distance separation on all sides for a three person engine crew. One acre is approximately the size of a football field or exactly 208 feet x 208 feet.

Downhill Checklist

Downhill fireline construction is hazardous in steep terrain, fast-burning fuels, or rapidly changing weather. Downhill fireline construction should not be attempted unless there is no tactical alternative. When building downhill fireline, the following is required:

1. Crew supervisor(s) and fireline overhead will discuss assignments prior to committing crew(s). Responsible overhead individual will stay with job until completed (TFLD or ICT4 qualified or better).
2. Decision will be made after proposed fireline has been scouted by supervisor(s) of involved crew(s).
3. L.C.E.S. will be coordinated for all personnel involved.
 - Crew supervisor(s) is in direct contact with lookout who can see the fire.
 - Communication is established between all crews.
 - Rapid access to safety zone(s) in case fire crosses below crew(s).
4. Direct attack will be used whenever possible; if not possible, the fireline should be completed between anchor points before being fired out.
5. Fireline will not lie in or adjacent to a chute or chimney.
6. Starting point will be anchored for crew(s) building fireline down from the top.
7. Bottom of the fire will be monitored; if the potential exists for the fire to spread, action will be taken to secure the fire edge.

Strategy - *Direct Attack*

Advantages

- Minimal area is burned; no additional area is intentionally burned.
- It's the safest place to work; firefighters can usually escape into the burned area.
- The possibility of fire moving into the brush or crowns of trees is reduced.
- The uncertainties of burning out or back-firing can be reduced/eliminated.

Disadvantages

- Firefighters can be hampered by heat, smoke and flames.
- Control lines can be very long and irregular because the line follows the edge of the fire.
- Burning material can easily spread across mid-slope lines.
- May not be able to use natural or existing barriers.
- More mop-up and patrol is usually required.

Strategy - *Indirect Attack*

Advantages

- The line can be located along favorable topography.
- Natural or existing barriers can be used.
- Firefighters may not have to work in smoke and heat.
- The line can be constructed in lighter fuels.
- There may be less danger of slopovers.

Disadvantages

- More area will be burned.
- Must be able to trade time and space to allow line to be constructed and fired.
- Firefighters may be placed in more danger because they are distant from the fire and can't observe it.
- There may be some dangers related to burning out or backfiring.
- Burning out may leave unburned islands of fuel.
- May not be able to use line already built.

Wildland-Urban Watch Outs

- Poor access and narrow one-way roads
- Bridge load limits
- Wooden construction and wood shake roofs
- Power lines, propane tanks, and HazMat threats
- Inadequate water supply
- Natural fuels 30' or closer to structures
- Structures in chimneys, box canyons, narrow canyons, or on steep slopes (30% or greater)
- Extreme fire behavior
- Strong winds
- Evacuation of public (panic)
- Don't park under power lines.
- Don't apply straight stream to power lines.

Power Line Safety for Wildland Fires

Fire activity close to high voltage electrical transmission/distribution lines can cause multiple hazards which can electrocute or seriously injure firefighters.

- It is the responsibility of the IC and line supervisors to be aware of and communicate power line hazards to all resources.
- Contact power companies when power lines are threatened or involved.

Down Power Lines

- **Communicate** – Notify all responders of down electrical lines. Obtain radio check-back.
- **Identify** – Determine *entire* extent of hazard by visually tracking all lines two poles in each direction from the downed wire.
- **Isolate** – Flag area around down wire hazards. Post guards.
- **Deny Entry** – delay firefighting actions until hazard identification and flagging is complete and/or confine actions to safe areas.
- Downed line on vehicle: stay in vehicle until power company arrives. If vehicle is on fire, jump clear, but don't hang on. Keep feet together and shuffle or hop away.
- **Always treat downed wires as energized!**

Ground Tactics

- Normal tactics apply when fire is more than 100' from power lines.
- Heavy smoke and flames can cause arcs to ground. Direct attack must be abandoned within 100' of transmission lines.
- Spot fires or low ground fires can be fought with hose lines if heavy smoke or flame is not within 100' of power lines.
- Always maintain 35' distance from transmission towers.
- Never use straight streams or foam. Use 30° fog pattern at minimum distance of 33 feet/10 meters.
- Use extreme caution and contact power company if engaging in tactical firing operations.
- Extinguish wooden poles burning at the base to prevent down wire hazards.

Aerial Tactics

- Communicate locations of all transmission lines to air resources.
- Aerial drops onto power lines will cause arcing to ground or arcing to power line towers and poles.
- Drops should be parallel to lines and avoid towers.

ALWAYS!

- **Look Out** for any power lines near the incident.
- **Communicate** location of all power lines that present a hazard.
- **Escape Routes** should not be under or near overhead power lines.
- **Safety Zones / ICP's / Staging Areas** should not be located under or near overhead power lines.

Structure Assessment Checklist

Address/Property Name

- Numerical street address, ranch name, etc.
- Number of residents on site

Road Access

- Road surface driveable
- Adequate width
- Turnouts, turnarounds
- Bridges (load limits)
- Stream crossings
- Grade (greater than 15%?)

Structure/Building

- Single residence/multi complex/out building
- Exterior walls
- Large unprotected windows facing heat source
- Proximity of any above-ground fuel tanks
- Roof material
- Eaves
- Other features (wood deck, wood patio cover and furniture, wood fencing)

Clearances/Exposures/Defensible Space

- Structure location (narrow ridge, canyon, mid-slope, chimney)
- Adequate clearance-minimum of 30'
 - (Steep slopes = more clearance)
 - (Heavier fuels = more clearance)
- Trees, ladder fuel, shrubs adjacent to structure
- Other combustibles near structure (wood piles, furniture, fuel tanks)
- Adequate clearance around fuel tank
- Power lines or transformers

Hazardous Materials

- Chemicals, pesticides, herbicides, petroleum products, paint

Water Sources

- Hydrant/standpipe, storage tank, pool, hot tub, pond, irrigation ditch

Evacuation

- Identify safe evacuation routes and refuge
- Coordinate with on-scene law enforcement and emergency services personnel.

Estimated Resources for Protection

- Number(s) and type(s) of engines, water tenders, crews, dozers, aircraft.

Structure Protection Guidelines

Firefighter safety and survival is the number one priority.

Equipment Placement

- Identify escape routes and safety zones.
- ALWAYS STAY MOBILE.
- Back equipment in for quick escape.
- Mark entrance to long driveways to show that protection is in place.
- Park in a cleared area.
- Keep egress route clear.
- Have protection line charged.
- DO NOT make long hose lays.
- Keep sight contact with all crewmembers.

Water Use Guidelines

- Keep at least 100 gallons reserve.
- Top off tank at every opportunity.
- CONSERVE WATER. Apply water only if it controls fire spread or significantly reduces heating of structure.
- Keep fire out of the heavier fuels.
- Knock down fire in the lighter fuels.
- Have enough water to last duration of main heat wave and to protect crew.

Class A Foam Use Guidelines

- Direct Attack - apply to base of flame.
- Indirect Attack - lay out wet line and burn out.
- Apply to structure (roof and siding) 10-15 minutes before fire arrives.

Preparing Structure

- Determine if residents are home.
- Place ladder on side with least fire threat and away from power drop.
- Clean roof of combustible materials.
- Cover vents.
- Remove and scatter fuels away from structure (ladder fuels, wood piles, etc.).
- Clear area around above-ground fuel tank, shutting off tank.
- Place combustible outside furniture inside structure.
- Close windows and doors, including garage, leaving unlocked. **AS A LAST RESORT, YOU MAY NEED TO USE STRUCTURE AS REFUGE.**
- Have garden hose(s) charged.

INCIDENT COMPLEXITY ANALYSIS (TYPE 3,4,5)	Yes	No
Fire Behavior		
Fuels extremely dry and susceptible to long-range spotting or you are currently experiencing extreme fire behavior.		
Weather forecast indicating no significant relief or worsening conditions.		
Current or predicted fire behavior dictates indirect control strategy with large amounts of fuel within planned perimeter.		
Firefighter Safety		
Performance of firefighting resources affected by cumulative fatigue.		
Overhead overextended mentally and/or physically.		
Communication ineffective with tactical resources or dispatch.		
Organization		
Operations are at the limit of span of control.		
Incident action plans, briefings, etc. missing or poorly prepared.		
Variety of specialized operations, support personnel or equipment.		
Unable to properly staff air operations.		
Limited local resources available for initial attack.		
Heavy commitment of local resources to logistical support.		
Existing forces worked 24 hours without success.		
Resources unfamiliar with local conditions and tactics.		
Values to be protected		
Urban interface; structures, developments, recreational facilities, or potential for evacuation.		
Fire burning or threatening more than one jurisdiction and potential for unified command with different or conflicting management objectives.		
Unique natural resources, special-designation areas, critical municipal watershed, T&E species habitat, cultural value sites.		
Sensitive political concerns, media involvement, or controversial fire policy.		

If you have checked "Yes" on 3 or more of the analysis boxes—consider next level of incident management support

After Action Review

The climate surrounding an AAR must be one in which the participants openly and honestly discuss what transpired, in sufficient detail and clarity, so everyone understands what did and did not occur and why. Most importantly, participants should leave with a strong desire to improve their proficiency.

- An AAR is performed as immediately after the event as possible by the personnel involved.
- The leader's role is to ensure there is skilled facilitation of the AAR.
- Reinforce that respectful disagreement is OK. Keep focused on the *what*, not the *who*.
- Make sure everyone participates.
- End the AAR on a positive note.

What was planned?

What actually happened?

Why did it happen?

What can we do next time?

(Correct weaknesses/sustain strengths)

How to Properly Refuse Risk

Every individual has the right and obligation to report safety problems and contribute ideas regarding their safety. Supervisors are expected to give these concerns and ideas serious consideration. **When an individual feels an assignment is unsafe they also have the obligation to identify, to the degree possible, safe alternatives for completing that assignment.** Turning down an assignment is one possible outcome of managing risk.

A “turn down” is a situation where an individual has determined they cannot undertake an assignment as given and they are unable to negotiate an alternative solution. The turn down of an assignment must be based on an assessment of risks and the ability of the individual or organization to control those risks. Individuals may turn down an assignment as unsafe when:

1. There is a violation of safe work practices.
2. Environmental conditions make the work unsafe.
3. They lack the necessary qualifications or experience.
4. Defective equipment is being used.

- Individual will directly inform their supervisor that they are turning down the assignment as given. The most appropriate means to document the turn down is using the criteria (The Firefighting Orders, the Watch Out Situations, etc.) outlined in the Risk Management Process.
- Supervisor will notify the Safety Officer immediately upon being informed of the turn down. If there is no Safety Officer, notification shall go to the appropriate Section Chief or to the Incident Commander. This provides accountability for decisions and initiates communication of safety concerns within the incident organization.
- If the supervisor asks another resource to perform the assignment, they are responsible to inform the new resource that the assignment has been turned down and the reasons that it was turned down.
- If an unresolved safety hazard exists or an unsafe act was committed, the individual should also document the turn down by submitting a SAFENET (ground hazard) or SAFECOM (aviation hazard) form in a timely manner.

These actions do not stop an operation from being carried out. This protocol is integral to the effective management of risk as it provides timely identification of hazards to the chain of command, raises risk awareness for both leaders and subordinates, and promotes accountability.

Last Resort Survival

LOOK AT YOUR OPTIONS AND IMMEDIATELY ACT ON THE
BEST ONE!

UTILIZE ALL P.P.E.!

PROTECT YOUR AIRWAY!

Escape if you can:

- Drop any gear not needed for fire shelter deployment (keep your fire shelter, handtool, quart of water, and radio).
- You may be able to use the fire shelter for a heat shield as you move.
- In LIGHT FUELS, you may be able to move back through the flames into the black.
- If you are on the flank of the fire, try to get below the fire.
- Consider vehicles or helicopters for escape.

Find a survivable area:

- Stay out of hazardous terrain features.
- Use bodies of water that are more than 2 feet deep.
- In LIGHT FUELS, you may be able to light an escape fire.
- In other fuels, you may be able to light a backfire.
- Call for helicopter or retardant drops.
- Cut and scatter fuels if there is time.
- Use any available heat barriers (structures, large rocks, dozer berms).
- Consider vehicle traffic hazards on roads.

Pick a fire shelter deployment site:

- Find the lowest point available.
- Maximize distance from nearest aerial fuels or heavy fuels.
- Pick a surface that allows the fire shelter to seal and remove ground fuels.
- Get into the fire shelter before the flame front hits.
- Position your feet toward the fire and hold down the fire shelter.
- Keep your face pressed to the ground.
- Deploy next to each other and keep talking.

Expect:

- Extremely heavy ember showers.
- Superheated air blast to hit before the flame front hits.
- Noise and turbulent powerful winds hitting the fire shelter.
- Pin holes in the fire shelter that allow fire glow inside.
- Heat inside the shelter = Extreme heat outside.
- Deployments have lasted up to 90 minutes.
- When in doubt wait it out.

Vehicle Accident IC Checklist

Report on Conditions

- Hazards (fuel, electrical, traffic, access, etc.).
- Need for law enforcement, ambulance, helicopter, tow truck, extrication tools.
- Injuries (number of victims, severity).
- Vehicles (number, type).

Establish Traffic Control

- Place apparatus between oncoming traffic and rescuers. Keep exhaust from pointing at scene, victims.
- Place warning devices.
- Establish positive communications.

Assess Fire Hazard or Potential

- Take suppression action as needed if trained, equipped and authorized.
- Be aware of fuels running downgrade.

Perform Patient Assessment

- Provide first aid or triage assessment.
- If there are fatalities, do not give names or other information over radio that would reveal identity, and do not move body.

Begin Incident Report. Document All Events. Advise Agency Dispatcher of Changes

- Incident status (arrival of other units, patient transport, available on scene, etc.).

HazMat IC Checklist

Think Safety

- Assess situation.
- Safe approach, upwind/upgrade/upstream.
- Identify, isolate and deny entry.
- Notify agency dispatcher.
- Exact location, use GPS.
- Request needed assistance, identify a safe route.

Scene Management

- Goal is to protect life, environment and property.
- Attempt to identify substance using DOT North American Emergency Response Guide. Use binoculars, placards/labels, container shapes/colors, Material Safety Data Sheets (MSDS), shipping papers.
- Quantity of material involved.
- Exposures and hazards surrounding the site.

Organizational Responsibilities

- Establish chain of command.
- Develop action plan for area security and evacuation.
- Advise all on scene and responding resources of changes in situation.
- Keep dispatcher advised of changes.
- Document all actions taken:
 - Contacts
 - Employee exposures

General Guidelines For Isolation Distances

- Minor event (1 drum, 1 bag, etc.) = 150 feet
- Major event (1 drum or more, etc.) = 500 feet
- Residential and light commercial = 300 feet
- Open areas = 1000 feet
- BLEVE (Boiling Liquid Expanding Vapor Explosion) potential = 2500 feet (one-half mile)
- Stage arriving units 2500 feet upwind
- Position vehicles headed out

1-800-424-9300 - CHEMTREC

(Chemical Transportation Emergency Center)

For immediate information about a chemical or to seek assistance from a manufacturer.

1-800-424-8802 - National Response Center

To report spills of oil and Hazardous Material.

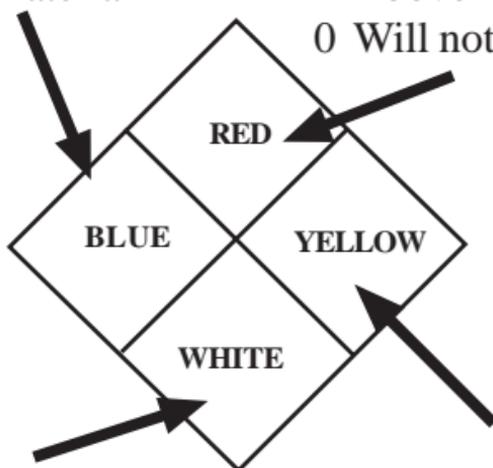
NFPA 704 HazMat Classification For Fixed Facilities

HEALTH HAZARD

- 4 Deadly
- 3 Extreme Danger
- 2 Hazardous
- 1 Slightly Hazardous
- 0 Normal Material

FIRE HAZARD

- 4 Below 73°F
- 3 Below 100°F
- 2 Above 100°F not exceeding 200°F
- 1 Above 200°F
- 0 Will not burn



SPECIFIC HAZARD

- ACID - Acid
- ALK - Alkali
- COR - Corrosive
- OXY - Oxidizer
- P - Polymerization
- ☢ - Radioactive
- W - Use no water

REACTIVITY

- 4 May detonate
- 3 Shock & heat may detonate
- 2 Violent chemical change
- 1 Unstable if heated
- 0 Stable

Major Disaster Considerations

- Assess crews for injuries.
- Move apparatus out of station if possible.
- Assess the station for damage.
- Determine if phones are working.
- Check for power - normal or auxiliary?
- Monitor phone and radio for dispatch information.
- Report by radio to dispatch or IC if established.
- Initiate a “windshield survey” of first response area.
- Do not fully commit to any incident.
 - Prioritize incidents with respect to life, hazard, property.
 - Note any damage to infrastructure (roads, bridges, etc.).
 - Check for hazardous utility situations (gas, electric, water).
 - Note structural instability/collapse of any buildings.
 - Expect malfunctioning automatic alarms.
 - Use “negative reporting.” Only report things out of the ordinary.
- Follow local disaster plans.

Structural Triage and Search

Assessment Marking

Never enter a damaged structure unless trained, equipped and authorized. You may find a 2' x 2' box at the entrance (or an arrow to indicate the entrance) to the compromised structure. Orange spray paint or a lumber crayon should be used to mark hazards and condition inside the box.

- Structure is safe for Search and Rescue (SAR) (minor damage, or structure is fully collapsed).
- Structure is significantly damaged with some safe areas, but other areas which need to be shored up or braced. Falling and collapse hazards need to be removed.
- Structure is unsafe for SAR. May collapse suddenly.
- ← Entrance is located in direction of the arrow.

HM Hazardous material is present (note type of material). Consult HazMat Team and cooperate.

Time, date, specialist ID and HazMats identified should be written outside the upper right portion of the box. Building may be re-evaluated for additional hazards.

✓ Single slash (2' long) indicates SAR Team is currently in structure conducting operations.

✗ Cross/slash (2' x 2') indicates SAR Team has left structure, area.

The following information should be found in the 4 quadrants of the cross/slash:

Team ID

Time & date team left structure

Personnel hazards

Number victims still inside structure

(An "X" indicates no victims remaining)

Left quad.

Upper quad.

Right quad.

Lower quad.

Unexploded Ordnance (UXO)

- Recognizing unexploded ordnance (UXO) is the first and most important step in reducing the risk posed by UXO.
- The following types of UXO are most likely to be encountered on military, former military and non-military sites:

Small arms munitions	Projectiles
Grenades	Rockets
Mortars	Guided missiles
Bombs	Submunitions
- UXO may be found fully intact or in fragments. All UXO, whether intact or in fragments, presents a potential hazard and should be treated as such.
- Deteriorated UXO presents a particular hazard because it may contain chemical agents that could become exposed.
- UXO poses risk of injury or death to anyone in the vicinity.

UXO Safety and Reporting.

- If you see UXO, stop. Do not move closer.
- Never transmit radio frequencies (walkie talkies, citizens' band radios).
- Never remove anything near UXO.
- Never touch, move, or disturb UXO.
- Clearly mark the UXO area.
- Avoid any area where UXO is located.
- Keep a minimum of 500 feet away from any UXO that is on fire.
- Report discovery of UXO to your immediate supervisor.

“IF YOU DIDN’T DROP IT, DON’T PICK IT UP!”

Evaluating Search Urgency

<u>FACTOR</u>	<u>RATING</u>
AGE	
Very Young	1
Very Old	1
Other	2-3
MEDICAL CONDITION	
Known/suspected injured, ill or mental problem	1-2
Healthy	3
Known Fatality	3
NUMBER OF SUBJECTS	
One alone	1
More than one (unless separated)	2-3
SUBJECT EXPERIENCE PROFILE	
Inexperienced, does not know area	1
Not experienced, knows area	1-2
Experienced, not familiar with area	2
Experienced, knows area	3
WEATHER PROFILE	
Past and/or existing hazardous weather	1
Predicted hazardous weather (less than 8 hours away)	1-2
Predicted hazardous weather (more than 8 hours away)	2
No hazardous weather predicted	3
EQUIPMENT PROFILE	
Inadequate for environment and weather	1
Questionable for environment and weather	1-2
Adequate for environment and weather	3
TERRAIN/HAZARDS PROFILE	
Known terrain or other hazards	1
Few or no hazards	2-3
TOTAL	

(Range = 7-21, with 7 the highest urgency and 21 the lowest urgency)

Patient Assessment

Patient Information:

- Name
- Weight
- Date of Birth/Age
- Sex
- Major complaint

Oriented to:

- Person
- Place
- Time
- Event

Level of Consciousness

- Alert
- Verbal (responds to voice)
- Pain (responds to painful stimuli)
- Unresponsive

Breathing

- Normal
- Difficult/labored breathing
- Not breathing – **START RESCUE BREATHING**

Pulse:

- Present
- Absent – **START CPR**

Pupils

- Equal and reactive to light
- Fixed
- Unequal
- Dilated
- Constricted

Skin Condition:

Color

- Normal
- Pale
- Bluish
- Flushed/red

Moisture

- Normal
- Dry
- Moist/clammy
- Profuse sweating

Temperature

- Normal
- Hot
- Cool
- Cold

Patient History - SAMPLE

- S** - Symptoms
- A** - Allergies to medications
- M** - Medication the patient is taking (Over-the-counter, herbal, prescription)
- P** - Past medical history (cardiac, seizures, diabetes, other)
- L** - Last oral intake (food or liquid)
- E** - Events preceding the emergency

First Aid Guidelines

LEGALITY

Do only what you know how to do and keep records of what you do for the patient.

BLOODBORN PATHOGENS

Personal protective equipment (pocket mask, water-proof gloves and goggles) should be worn if contact with body fluids is possible.

TREATMENT PRINCIPLES

- Prevent further injury - remove from danger.
- Fast Exam - airway, breathing, and circulation.
- Thorough Patient Assessment - head to toe and side to side.
- No liquids for the unconscious or semi-conscious patient.
- Keep readable records and send a copy with the patient.

MEDICAL EMERGENCY PROCEDURES

- Stabilize patient, contact medical assistance, make transport decision.
- ALL injuries must be reported to direct supervisor.
- In case of medical emergency, contact incident supervisor or communications dispatcher.
- Identify: Nature of incident, # injured, patient assessment(s) and location (Geographic & GPS coordinates).
- DO NOT USE THE PATIENTS NAME ON THE RADIO.
- Limited visibility may delay or negate air transport.

Specific Treatments

Bleeding: Direct pressure, elevate, and pressure point.

Shock: Lay patient down, elevate feet, keep warm and replace fluids if conscious.

Fractures: Splint joints above and below injury and monitor pulse past injury away from body.

Head Injury: Stabilize patients head and neck, maintain airway.

Bee Sting or other lethal allergic reaction: Rash, face or airway swelling, difficulty talking/breathing. If the patient has a bee sting kit, assist them in using the medication and begin transport immediately.

Burns: Remove heat source, cool with water, dry wrap and replace fluids if conscious.

Eye Injuries: Wash out foreign material, don't open swollen eyes, leave impaled objects. Pad and bandage both eyes.

Heat Exhaustion: Skin pale or flushed, cool and clammy. Rest in cool place. Drink electrolyte replacement fluids and water.

Heat Stroke (Life Threatening): Skin dry, pale or red, temperature hot. Cool skin surface and begin transport immediately.

CPR

Determine responsiveness - Gently shake shoulder and shout: "Are you OK?" If no response, call EMS. If alone, call EMS before starting **ABCs** (airway, breathing, circulation).

Airway - roll victim on back as a unit supporting head and neck. Open airway by head-tilt/chin-lift maneuver. Look, listen and feel for breathing for 3 to 5 seconds. If no response, go to **Breathing**.

Breathing - Pinch victim's nose shut. Place CPR shield over patient's mouth. Put mouth over victim's, making a tight seal. Give 2 slow breaths. If chest does not rise, reposition and try again. If breaths still do not go through, use abdominal thrusts to clear airway. If chest does rise, go to **Circulation**.

Circulation - Check carotid (neck) pulse for 5 to 10 seconds. If there is a pulse but no breathing, give 1 breath every 5 seconds until victim is breathing or help arrives. If no pulse, begin chest compressions.

One/Two Rescuer CPR - For one rescuer, perform 15 external chest compressions at the rate of 80 to 100 times per minute to a 1.5 to 2" depth. Reopen airway and give 2 full breaths. After 4 cycles of 15:2 (about 1 minute), check pulse. If no pulse, continue 15:2 cycle beginning with chest compressions until advanced life support is available. If two rescuers are available, one rescuer does check compressions, while the second rescuer gives breaths, etc. Use a 5:1 ratio for children and infants with compressions at a rate of 100 times per minute. Use a 1 to 1.5" depth for children and a .5 to 1" depth for infants.

START Triage - **Assess, Treat**
 Find color, STOP, TAG, MOVE ON

M I N O R * G R E E N	<Move Walking Wounded			
	D E C E A S E D * B L A C K	<No Resp after head tilt		
		I M M E D I A T E * R E D	<Breathing but Unconscious	
			<Resp - > 30	
			<Perfusion Cap refill > 2 sec or No Radial Pulse <i>Control bleeding</i>	
			<Mental Status – Can't follow simple commands	
			D * E Y L E A L Y L E O D W	<Otherwise
		Remember R – <30 P – <2 M – Can do		

Disaster Size-up Information

TRIAGESYSTEM

<u>Color</u>	<u>Priority</u>	<u>Description</u>
Red	Immediate	Serious, salvageable, life-threatening injury or medical problem.
Yellow	Delayed	Treatment and transportation can be delayed.
Green	Minor	“Walking wounded” whose treatment can be delayed until all others are cared for.
Black	Dead/ dying	Dead or those with grave injuries likely to result in death.

Burn Injury Treatment

- Remove person from heat source, extinguish with water.
- Examine airway for burns (singed facial hair, nasal hairs, soot or burns around or in nose, mouth, or black sooty sputum).
- Examine for other injuries.
 - Provide basic first aid.
 - Maintain airway, breathing, circulation (ABCs).
 - Treat for shock by keeping person warm, feel elevated.
 - Provide oxygen, if available trained to administrator.
- Assess degree of burn and area affected.

First Degree - affected skin's outer layer. Redness, mild swelling, tenderness, and mild to moderate pain.

Second Degree - extends through entire outer layer and into inner layer of skin. Blisters, swelling, weeping of fluids, and severe pain.

Third Degree - extends through all skin layers and into underlying fat, muscle, bone. Discoloration (charred, white or cherry red), leathery, parchment-like, dry appearance. Pain is absent.

Rule of Palms: Patients palm = 1% of their body surface. Estimate how many times the patients palm could be placed over the burned areas to estimate the % of body that has been burned.

- Cut away only burned clothing. DO NOT cut away clothing stuck to burned skin.
- Apply cool, clear water over burned area. DO NOT soak person or use cold water and ice packs. This encourages hypothermia.
- Cover burned area with sterile dressing, moisten with saline solution, and apply dry dressing on top.
- For severe burns or burns covering large area of body:
 - Wrap in clean, sterile sheet followed by plastic sheet.
 - Place inside sleeping bag or cover with insulated blanket.
- Monitor ABCs and keep burn areas moist.
- Avoid hypothermia and overheating.

Aviation User Checklist

- Pilot's Card—qualified and current for aircraft type and mission?
- Aircraft Card—aircraft approved for mission?
- Flight Plan/Following—filed (FAA/Agency/Bureau)?
- Personal Protective Equipment (PPE)—required for missions—available and worn by all passengers and pilot?
- Pilot briefed on Mission Objectives/Parameters of Flight and Known Flight Hazards?
- Pilot briefing to passengers?

Aviation Watch Out Situations

- Is this flight necessary?
- Who is in charge?
- Are all hazards identified and have you made them known?
- Should you stop the operation or flight due to change in conditions?
 - Communications
 - Weather
 - Confusion
 - Turbulence
 - Conflicting Priorities
 - Personnel
- Is there a better way to do it?
- Are you driven by an overwhelming sense of urgency?
- Can you justify your actions?
- Are there other aircraft in the area?
- Do you have an escape route?
- Are there any rules being broken?
- Are communications getting tense?
- Are you deviating from the assigned operation or flight?

Flight Manager

The Flight Manager (FM) is supervised by the sending unit dispatcher until destination is reached. The FM is responsible for all personnel assigned on the manifest list. Duties are:

- To explain to all personnel at the beginning of travel, transportation arrangements, type equipment, route of travel, stopping points, ETAs, etc.
- To have multiple copies of manifests covering all personnel.
- To ensure proper flight following procedures are met.
- To have the telephone numbers of the sending and receiving dispatchers' offices when delays of more than 30 minutes occur in order to give information as to why and how long the delay will be.
- To have all personnel within the weight limitations, assembled, ready to board transportation.
- To provide for safety and welfare of each person assigned to the manifest list.
- To ensure that guidelines for transport of hazardous materials are followed.
- To ensure no fuel- or lubricant-soaked items including clothing, chaps or bags are transported by aircraft.
- To check pilot card and aircraft data card for currency and qualifications.
- To ensure all passengers arrive at their destination.
- To sign the Daily Flight report/Invoices.
- To ensure all personnel have a copy of their resource order with request number and position assigned.
- For Canadian travel, to ensure proper documentation is included as outlined in the Canadian/United States Operating Agreement (chapter 40).

Helicopter Passenger Briefing

All passengers must receive a safety briefing prior to flight.

1. Personal Protective Equipment

- Appropriate head protection; Nomex clothing; ear and eye protection; boots; other survival equipment as applicable (PFD, life rafts, etc.).

2. Approach and Departure Paths

- When loading helicopters in uneven terrain, always approach and depart from the downslope (lower) side.
- Approach and depart helicopter in a crouch position.
- Keep in pilot's field of vision at all times.
- Stay clear of the landing area when helicopters are landing or departing.
- Never go near the tail of helicopters; do not approach airplanes from the front.

3. Tools and Equipment

- Secure hand tools and equipment awaiting transport (will not blow into rotor system).
- Carry tools or other long objects parallel to the ground, not over the shoulder into the air.
- Make assignments for carrying tools/equipment to and from the helicopter or airplane.

4. Seating in Aircraft

- No movement between seats unless authorized by pilot inside aircraft once seated.
- Seat belt fastened at all times.

- Unbuckle only when specifically directed to do so by pilot or helicopter loading/unloading personnel.
- Follow the instructions of pilot.
- Know location of all emergency exits.
- Know approved crash positions.
- Know location of first aid kit, survival kit, fire extinguisher, ELT (Emergency Locator Transmitter), fuel shut off switch, radio operation, normal and emergency operation of all doors/exits, oxygen (if available).

5. Security of Equipment

- Loose items secured and manageable; all baggage secured in aircraft or in compartment.
- Never throw any object from a helicopter or airplane.
- Around helicopters, never reach up or dart after a hat or other object that has become unsecured.

6. Smoking

- Rules in and around aircraft

7. In Flight Emergency Procedures

- Follow instructions of pilot/helicopter personnel.
- Assume appropriate crash position.
- Assist any injured person who cannot leave the aircraft.
- Move clear of the aircraft only after rotor blades stop or when instructed to do so by the pilot or helicopter crew.
- Assess situation, follow pilot/helicopter manager instructions, render first aid, pilot and/or helicopter manager to remove first aid kit, radio, ELT, and fire extinguisher.

Personal Protective Equipment for Flight

Agencies have personal protective equipment (PPE) requirements for most flights. When in doubt, WEAR IT.

- Above-the-ankle leather boots 8" or higher, and no metal against the skin.
- Nomex pants and shirt or flight suit buttoned or zipped to the top, collar turned up, sleeves rolled down. Pants cover the boot tops.
- Nomex or leather gloves.
- Non-synthetic (cotton, wool) outer and undergarments.
- Approved flight helmet or hard hat with chin strap (hard hats apply only to helicopter crew shuttle operations). Eye protection should be worn during takeoffs and landings. Wear eye protection when working around helicopters.
- Approved hearing protection.

Flight Following

Flight following, resource tracking, and communications are key components in employee and aircraft mission safety and efficiency. Flight following, whether performed from a dispatch office or other facility, or at a remote location in the field, must be given a high priority by all personnel involved.

Identification of Flight Following Requirements:

At the time the flight is planned, flight following requirements should be clearly identified. Requirements should identify check-in procedures, including time and locations, dispatch office(s) or other flight following facilities involved, individuals responsible for flight following, frequencies to be used, and any special circumstances requiring check-ins (for example, to military facilities within Special Use Airspace).

Check-In Requirements:

Check-in intervals or times must be specified in the agency's flight following procedures. Check-ins must be documented and provide enough information so that the aircraft can be easily located if it is overdue or missing.

Failure to Meet Check-In Requirements:

The dispatch or other flight following facility shall implement response procedures for overdue or missing aircraft.

Helicopter Landing Area Selection

Choosing a Landing Area:

- Locate a reasonably flat area.
- Choose an area clear of people, vehicles, obstructions such as trees, poles, and especially overhead wires. The area must be free of stumps, brush, posts, large rocks or anything over 18 inches high.
- Consider the wind direction. Helicopters land and take off into the wind. Choose an approach free of obstructions.
- Any obstruction should be relayed to the helicopter crew on initial radio contact.
- Remove or secure any loose items in and around the landing area such as trash, blankets, hats or equipment.
- Wet down the landing area if dusty conditions are present.
- Address LCES prior to staffing existing or proposed helicopter landing areas.

Fixed Helispots

Type I Helicopters

- Safety circle 110 feet
- Touchdown pad 30 feet x 30 feet clear and level

Type II Helicopters

- Safety circle 90 feet
- Touchdown pad 20 feet x 20 feet clear and level

Type III Helicopters

- Safety circle 75 feet
- Touchdown Pad 15 feet x 15 feet clear and level

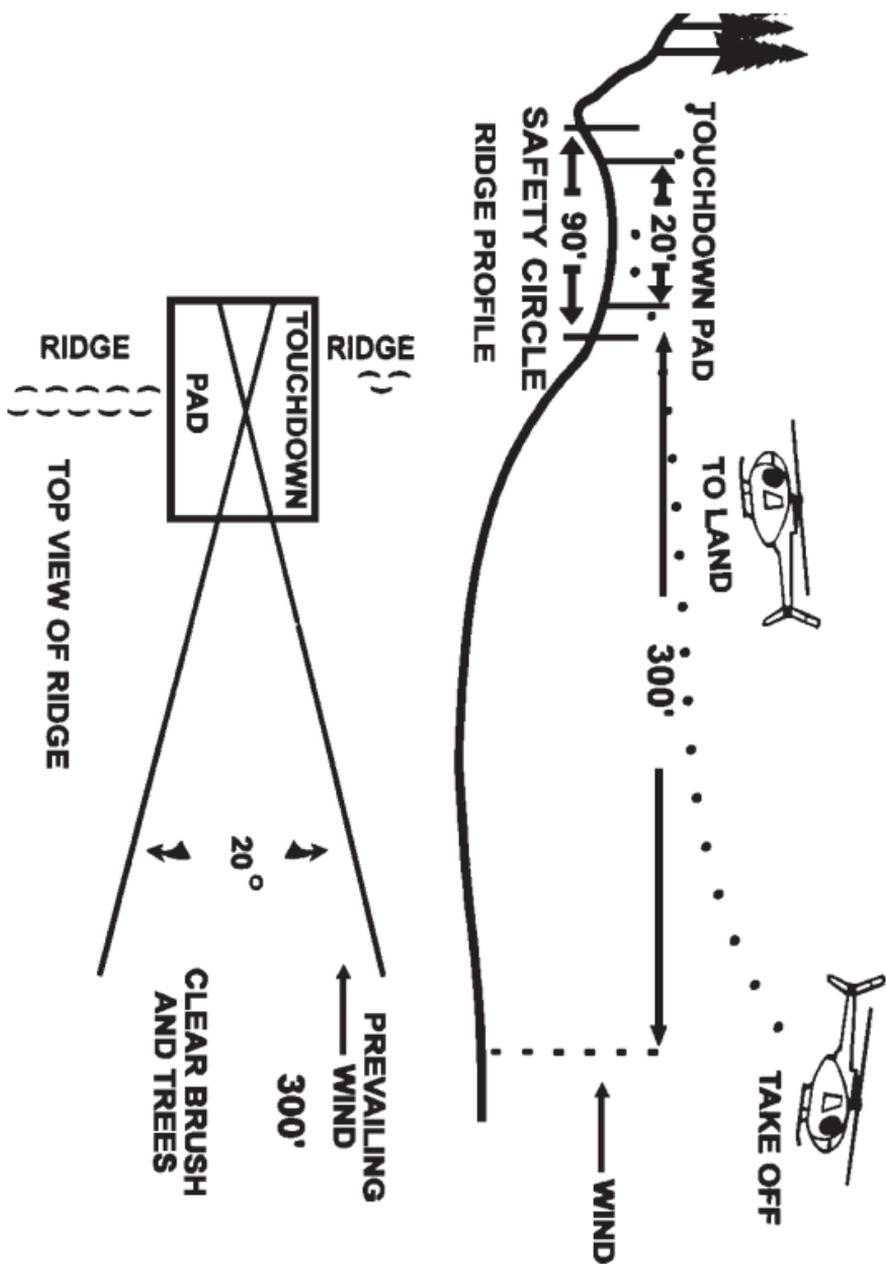
Items Needed:

- 40 BC fire extinguisher (20 lb.)
- Wind Indicator
- Radio-compatible with helicopter
- Pad Marker
- Allowable Payloads (HIGE & HOGE) for all helicopters using helispot
- Passenger/Cargo Manifest Book
- Dust abatement, as needed

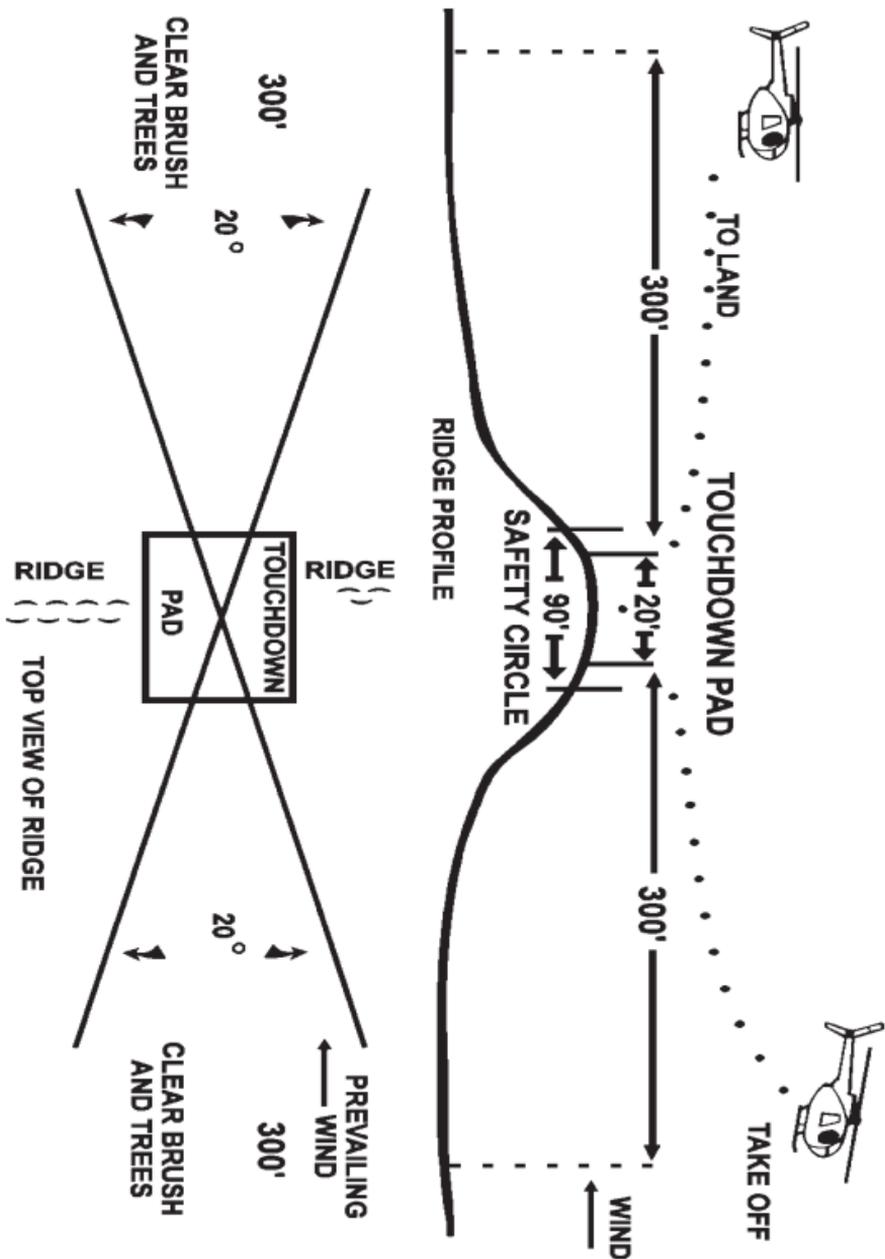
Longline Mission

- All individuals involved in longline missions will have been trained in longline operations.
- If you are on the receiving end or the backhaul end of a longline load, you must be able to communicate to the pilot where you want the load delivered or picked up.
- Use a signal mirror to identify your position to the pilot.
- The drop-off/pick-up area should be as open and free of obstacles as possible.
- Once you have contacted the pilot by radio, give him/her all the information you can (cargo weight, wind speed and direction, etc.).
- Mark the drop-off spot with flagging (large “X” on the ground) if possible.
- Keep pilot informed of load status (height above the ground, clear of obstacles, etc.).
- Let the hook land on the ground before attaching load.
- If the electrical release does not release the load, you must manually release it; wait until the hook lands on the ground before releasing.
- For ALL backhaul, a “swivel” must be connected to the cargo/longline hook. NO EXCEPTIONS! (When you request nets, request swivels also.)
- Load cargo net with heavy items in the center, light items on top. Tape all boxes and loose items.
- Pull the “purse strings” of the cargo net to equal length and attach a swivel to the steel rings. It’s not necessary to “cross” the purse strings with an overhand wrap. The preferred method is to make an oversized collar out of fiber tape that will slip down the purse strings as the load is lifted.

One-Way Helispot



Two-Way Helispot



Helicopter Hand Signals



Clear to Start

Make circular motion above head w/arm



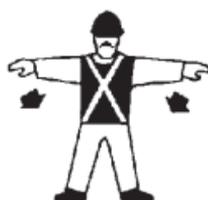
Hold on Ground

Extend arms at 45 thumbs down



Move Upward

Arms extended sweeping up



Move Downward

Arms extended sweeping down



Hold Hover

Arms extended w/clenched fists



Clear to Take-Off

Arms extended in take-off direction



Land Here

Extend arms w/wind at back



Move Forward

Arms extended & wave copter toward you



Move Rearward

Arms downward using shoving motion



Move Left

Right arm extended left arm sweeps overhead



Move Right

Opposite of move left



Move Tail Rotor

Rotate body w/one arm extended



Shut Off Engine

Cross neck w/hand palm down



Fixed Tank Doors

Open arms outward Close arms inward



Release Sling Load

Contact forearm w/other hand



Wave Off Don't Land

Wave arms & cross overhead

Weight Estimates

(use only if scale is not available)

<u>Item</u>	<u>Weight</u>
Blevet bag	15 lbs.
Backpack pump (full)	45 lbs.
Cargo net 12x12	20 lbs.
Cargo net 20x20	45 lbs.
Cargo net (fish net)	5 lbs.
Cargo hook (1 hook)	35 lbs.
Jerry can/fuel (5 gal.)	45 lbs.
Canteen (1 gal.)	10 lbs.
Dolmar (full)	15 lbs.
Drip torch (full)	15 lbs.
Fusee (1 case)	36 lbs.
Hand tool (each)	8 lbs.
Lead line (12 ft.)	10 lbs.
Long line (50 ft.)	30 lbs.
Swivel	5 lbs.
Chain saw	25 lbs.
Hose, 1½" SYN. 100'	23 lbs.
Hose, 1" SYN. 100'	11 lbs.
Hose, ¾" SYN (1000'/case)	30 lbs.
Hose, suction, 8 ft.	10 lbs.
Mark 3 - Pump w/kit	150 lbs.
Stokes w/ backbrd.	40 lbs.
Trauma bag	35 lbs.
M.R.E., 1 case	25 lbs.
Cubee/water (5 gal.)	40 lbs.

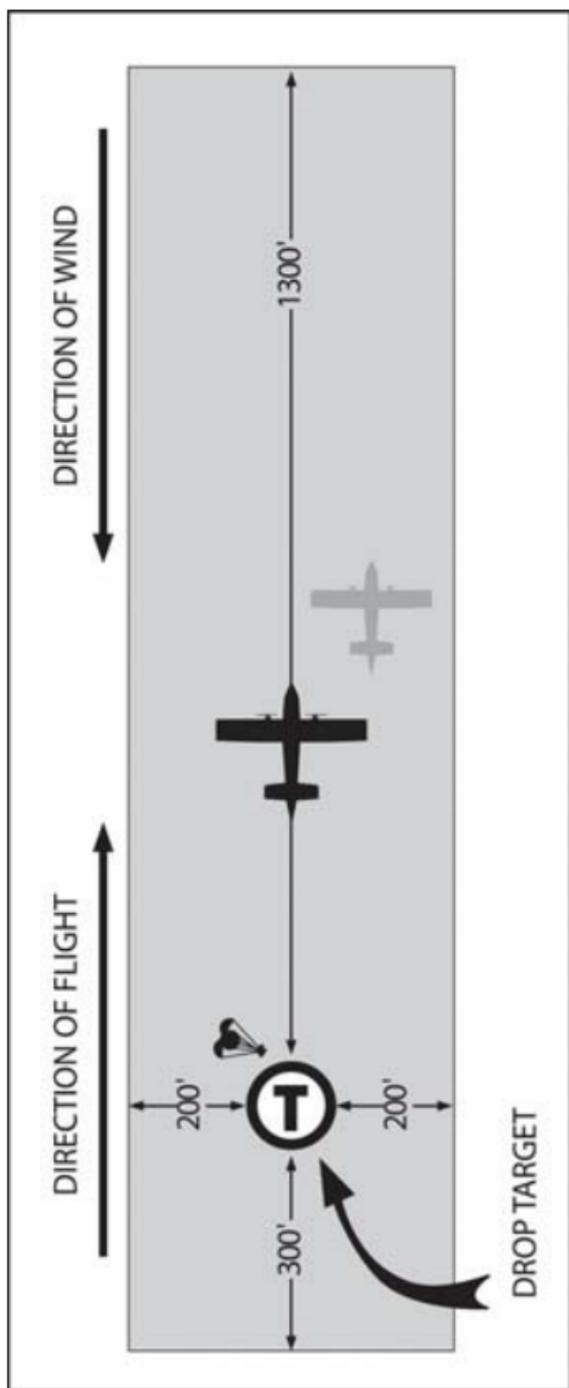
Paracargo and Aerial Retardant Operations Safety

The paracargo danger zone is a strip of 200 feet on each side of the flight path, 300 feet in the direction of approach, and 1300 feet in the direction of the aircraft when it leaves the target. The following should be observed at all times:

- Mark target area with white or orange “T” in open or cleared area with top of “T” into the wind. Erect paper streamer or flagging on long pole to indicate wind direction.
 - An individual should be in charge at drop site.
 - All persons, vehicles, and animals should be cleared from the danger zone prior to arrival of the cargo aircraft.
 - Camps should be at least 600 feet from target area and outside of danger zone.
 - Allow no one in danger zone until drop is complete.
 - Beware of “streamers” or parachutes that don’t open.
-

Personnel can be injured by the impact of material dropped by aircraft. Clear personnel out of target area when drop is to be made. If you can’t escape:

- Hold your handtool away from your body.
- Lie face down with head toward oncoming aircraft and hardhat in place. Grasp something firm to prevent being carried or rolled about by the dropped liquid.
- Do not run unless escape is assured.
- Get clear of dead snags, tops and limbs in drop area.
- Working in an area covered by wet retardant should be done with caution due to slippery surfaces.



Paracargo drop zone

Principles of Retardant Application

- Determine tactics direct or indirect based on fire size-up and resources available.
- Establish an anchor point and work from it.
- Use the proper drop height.
- Apply proper coverage levels. (See next page.)
- Drop downhill and down-sun when feasible.
- Drop into the wind for best accuracy.
- Maintain honest evaluation and effective communication between the ground and air.
- Use direct attack only when ground support is available or extinguishment is feasible.
- Plan drops so they can be extended or intersected effectively.
- Monitor retardant effectiveness and adjust its use accordingly.

Directing Retardant and Bucket Drops

- **Give general location** on incident.
- **Finalize location** with:
 - Clock direction - straight in front of the aircraft is 12 o'clock, out the right door is 3 o'clock, the tail is 6 o'clock, and the left door is 9 o'clock. When giving directions, remember that helicopters and air attack generally orbit in a right-hand pattern and air tankers in a left-hand pattern.
 - Position on slope - lower 1/3, upper 1/3, midslope, top of ridge, etc.
 - Aspect - direction slope is facing.
 - Describe prominent landmarks - don't say "I have a red hardhat, I'm wearing a yellow shirt, I'm waving, I'm by the big rock," etc. Visualize what the pilot sees from the air and describe target.
 - Use signal mirrors - use smoke or fusee if mirror unavailable. Stand in drop location (when safe) for ID and move away before drop.
- **Describe target** from your location and explain mission. The pilot will decide drop technique and flight path.
- **Assure pilot** all personnel are safe and know aircraft intentions before the drop.
- **Give feedback** to pilot about drop accuracy. Be honest and constructive. Let pilot know if drop is early, late, uphill, downhill, on target, too high, too low, etc. Report low drops immediately.

Effective Use of Single Engine Air Tankers

- 1. Get them flying early.**
 - SEATs are most effective during initial attack operations if used as a quick response resource.
 - Develop a quick, proactive, IA response to incidents.
- 2. Keep them flying to increase operational efficiency.**
 - By moving the SEAT to a location in close proximity to the incident, the efficiency of the resource multiplies.
 - Mobility is the key.
- 3. Utilize aerial supervision whenever available.**
 - This will reduce “time over target” and facilitate additional missions.
 - Will also help manage the single pilot workload in the fire environment.
- 4. Integrate SEATs with other resources as a “close air support” tool.**
 - Integrate with ground resources as a support tool.
 - Incorporate as a supplemental resource for structure protection.

- 5. Consider working SEATs in tandem.**
 - This will multiply the amount of retardant/suppressant delivered to the incident.
 - Will also reduce time between deliveries of retardant to the incident.

- 6. Long fireline construction will require multiple SEATs.**
 - You can build line with SEATs but, in order to be efficient you will need multiple SEATs and short turn around times.

- 7. Consider using SEATs with retardant or suppressants.**
 - SEATs can be effective when used with retardant or suppressants.
 - Notify ground firefighters as to the type of material being used to facilitate a change of tactics if necessary.

- 8. SEATs are not heavy air tankers.**
 - When utilized properly, SEATs can be a highly effective resource.
 - Do not have unrealistic expectations.
 - A retardant coverage level of 4 is a good rule of thumb for SEATs.

Aircraft Mishap Response Actions

Time is extremely critical when responding to an emergency. Immediate positive action is necessary; delay may effect someone's survival.

Rescue Operations

- Preserve life.
- Secure the area (deny access except to credentialed and escorted media).
- Do whatever is necessary to extricate injured occupants, and to extinguish fires, keeping in mind the necessity of protecting and preserving evidence.
- Document and/or photograph the location of any debris which must be disturbed in order to carry out rescues and/or fire suppression activities.

Site Safety Precaution

Aircraft wreckage sites can be hazardous for many reasons other than adverse terrain or climatic conditions. Personnel involved in the recovery, examination, and documentation of wreckage may be exposed to physical hazards posed by such as hazardous cargo, flammable and toxic fluids, sharp or heavy objects, and disease. It's important to exercise good judgment, use available protective devices and clothing, and use extreme caution when working in the wreckage. Do not exceed your physical limitations.

Reportable Safety Concerns

If a situation appears unsafe, discuss your concern with the pilot, or immediately contact your dispatcher or agency aviation representative for assistance.

Any safety concern should be documented on a SAFECOM and forwarded through agency channels. A SAFECOM is used to report any condition, observance, act, maintenance problem, or circumstance that has the potential to cause an aviation-related mishap. This type of follow-up helps improve overall aviation safety.

If the mishap involves damage or injury, notify the Agency's Aviation Safety Office (ASO) immediately by the most expeditious means available.

USDA-FS/USDI-AMD

24-Hour accident Reporting Hot Line

Dial 1-888-464-7427 or 1-888-4MISHAP

AMD Web Site - www.oas.gov

FS Web Site - www.fs.fed.us/fire/av_safety

USFS Visual Signal Code

Ground To Air

Require doctor, serious injury	—
Able to ride horse	<u>2</u>
Need stretcher crew	<u>3</u>
Broken leg	<u>4</u>
Broken arm	<u>5</u>
Broken back	<u>6</u>
Head injury	±
Puncture wound	<u>8</u>
Unable to diagnose	<u>9</u>
Jumper OK	L
Personnel OK	LL
Fire adequately staffed	≡
Change jump spot	J
Cargo drop target	<u>T</u>
Helicopter landing spot	H
Need cross-cut saw	S
Need power saw	SS
Need climbers	O
Need drinking water	U
Need food	F
Need radio with batteries	R
Need batteries for radio	RR
Need power pump outfit	PP
Received message	Wave streamer

Air to Ground

Received message		Rock plane
Fire here	Circle three times over spot	
Will drop message	Gun motor three times	

Spot Weather Forecast

Spot weather forecasts should always be requested for those fires that have potential for active fire behavior, exceed initial attack, or are located in areas where Red Flag Warnings have been issued.

The basic elements needed for a spot weather request include:

- Name of incident
- Location by ¼ section
- Fire size
- Elevation (at top and bottom of fire)
- Fuel type
- Fire character (ground fire, crowning, spotting, etc.)

Weather observations need to include:

- Location on the fire
- Observation time
- Wind direction
- Wind velocity
- Dry bulb
- Wet bulb
- Sky conditions and other remarks

Energy Release Component (ERC)

The Energy Release Component (ERC) is an NFDRS index related to how hot a fire could burn. It is directly related to the 24-hour, potential worst case, total available energy (BTUs) per unit area (in square feet) within the flaming front at the head of a fire.

The ERC can serve as a good characterization of a fire season as it tracks seasonal fire danger trends well. The ERC is a function of the fuel model and live and dead fuel moistures. Fuel loading, woody fuel moistures, and larger fuel moistures all have an influence on the ERC, while the lighter fuels have less influence and wind speed has none.

ERC has low variability, and is the best fire danger component for indicating the effects of intermediate to long-term drying on fire behavior (if it is a significant factor) although it is not intended for use as a drought index.

Burning Index (BI)

The Burning Index (BI) is an NFDRS index relating to the flame length at the head of the fire. BI is an estimate of the potential difficulty of fire control as a function of how fast and how hot a fire could burn. It has been scaled so that the BI value divided by 10 predicts the flame length at the head of a fire. For example, a BI of 75 would predict a flame length of 7.5 feet. BI is a function of the Spread Component and the Energy Release Component, and has moderate variability. It is sensitive to fuel models, and can trace seasonal trends reasonably well for models with heavy dead or live components. Because it uses wind and relative humidity, it is also very sensitive to weather observation errors.

Haines Index (HI)

The Lower Atmosphere Stability Index, or Haines Index, is for fire weather use. It is used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire. It is calculated by combining the stability and moisture content of the lower atmosphere into a number that correlates well with large fire growth. The stability term is determined by the temperature difference between two atmospheric layers; the moisture term is determined by the temperature and dew point difference. This index has been shown to correlate with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior. The Haines Index can range between 2 and 6. The drier and more unstable the lower atmosphere is, the higher the index.

- 2 - Very Low Potential (Moist Stable Lower Atmosphere)
- 3 - Very Low Potential
- 4 - Low Potential
- 5 - Moderate Potential
- 6 - High Potential (Dry Unstable Lower Atmosphere)

Keetch-Byrum Drought Index (KBDI)

0 - 200 Soil and fuel moisture are high. Most fuels will not readily ignite or burn. Expect a mosaic pattern of burned and unburned fuels. Once the fire passes, remaining embers extinguish quickly. Mop-up is minimal.

200 - 400 Fires more readily burn and will carry across an area with no “gaps”. Heavier fuels will still not readily ignite and burn. Expect smoldering and the resulting smoke to carry into and possibly through the night. Soil exposure will be minimal. Hand lines constructed to hold the fire should be composed of mineral soil.

400 - 600 Fire intensity begins to significantly increase at an exponential rate from the lower to the upper end of this range. Fires will readily burn in all directions exposing large areas of mineral soil. Complete consumption of all but the largest dead fuels. Larger fuels not consumed may burn or smolder for several days creating possible smoke and control problems. Expect lower live fuel moistures resulting from continued water loss in the soil. Reevaluate line construction and location standards.

600 - 800 Fires will burn to mineral soil. Stumps will burn to the end of underground roots, potentially burning under fire breaks. Spotting will be a major problem. Once ignited, large fuel classes will burn intensely with almost total consumption. Wilting understory vegetation contributes to fire intensity and creates ladder fuels. Expect fires to be difficult to contain and control.

Lightning Activity Level (LAL)

LAL 1 – No thunderstorms.

LAL 2 – Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1-5 cloud to ground strikes in a 5 minute period.

LAL 3 – Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6-10 cloud to ground strikes in a 5 minute period.

LAL 4 – Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11-15 cloud to ground strikes in a 5 minute period.

LAL 5 – Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a 5 minute period.

LAL 6 – Same as LAL 3 except thunderstorms are dry (no rain reaches the ground). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag Warning.

Thunderstorm Safety

Approaching thunderstorms may be noted by a sudden reverse in wind direction, a noticeable rise in wind speed, and a sharp drop in temperature. Rain, hail, and lightning occur only in the mature stage of a thunderstorm.

Observe the 30/30 rule: a) If you see lightning and hear thunderclaps within 30 seconds, take storm counter-measures identified below. b) Do not resume work in exposed areas until 30 minutes after storm activity has passed.

- Take shelter in a vehicle or building if possible.
- If outdoors, find a low spot away from tall trees, wire fences, utility lines and other elevated conductive objects. Make sure the place you pick is not subject to flooding.
- If in the woods, move to an area with shorter trees.
- If only isolated trees are nearby, keep your distance twice the tree height.
- If in open country, crouch low minimizing contact with the ground. You can use a pack to sit on, but never lay on the ground.
- If you feel your skin tingle or your hair stand on end, immediately crouch low to the ground. Make yourself the smallest possible target and minimize your contact with the ground.
- Don't group together.
- Don't stay on ridgetops, in wide open areas, near ledges or rock outcroppings.
- Don't operate land line telephones, machinery, or electric motors.
- Don't handle flammable materials in open containers or metal handtools.

Severe Fire Behavior Potential Related to Relative Humidity and Fuel Moisture Content

R.H. %	1-HR F.M. %	10-HR F.M. %	Relative ease of chance ignition and spotting; general burning conditions
>60	>20	>15	Very little ignition; some spotting may occur with winds above 9 mi./h.
45-60	15-19	12-15	Low ignition hazard--campfires become dangerous; glowing brands cause ignition when relative humidity is <50 percent.
30-45	11-14	10-12	Medium ignitability--matches become dangerous; "easy" burning conditions.
26-40	8-10	8-9	High ignition hazard--matches always dangerous; occasional crowning, spotting caused by gusty winds; "moderate" burning conditions.
15-30	5-7	5-7	Quick ignition, rapid buildup, extensive crowning; any increase in wind causes increased spotting, crowning, loss of control; fire moves up bark of trees igniting aerial fuels; long distance spotting in pine stands; dangerous burning conditions.
<15	< 5	< 5	All sources of ignition dangerous; aggressive burning, spot fires occur often and spread rapidly, extreme fire behavior probable; critical burning conditions.

Windspeed Ranges

Frontal winds Too broad a range to be specific.
 Foehn 40 to 60 mi/hr common; up to 90 mi/hr reported at 20 ft.
 Land breeze 2 to 3 hours after sunset, 3 to 5 mi/hr at 20 ft.
 Pacific sea breeze 10 to 15 mi/hr at 20 ft.
 Up-valley winds 10 to 15 mi/hr, early afternoon and evening at 20 ft.
 Upslope winds as high as 4 to 8 mi/hr at midflame height.
 Downslope winds 3 to 6 mi/hr at midflame height.

BEAUFORT SCALE FOR ESTIMATING 20-FT WINDSPEED

Wind Class	Wind Speed (mph)	Nomenclature
1	<3	Very light - smoke rises nearly vertically. Leaves of quaking aspen in constant motion; small branches of bushes sway; slender branches and twigs of trees move gently; tall grasses and weeds sway and bend with wind; wind vane barely moves.
2	4-7	Light - trees of pole size in the open sway gently; wind felt distinctly on face; loose scraps of paper move; wind flutters small flag.
3	8-12	Gentle breeze - trees of pole size in the open sway very noticeably; large branches of pole size trees in the open toss; tops of trees in dense stands sway; wind extends small flag; a few crested waves form on lakes.
4	13-18	Moderate breeze - trees of pole size in the open sway violently; whole trees in dense stands sway noticeable; dust is raised on the road.
5	19-24	Fresh - branchlets are broken from trees; inconvenience is felt in walking against wind.
6	25-31	Strong - tree damage increases with occasional breaking of exposed tops and branches; progress impeded when walking against wind; light structural damage to buildings.
7	32-38	Moderate gale - severe damage to tree tops; very difficult to walk into wind; significant structural damage occurs.
8	>39	Fresh gale - surfaced strong Santa Ana; intense stress on all exposed objects, vegetation, buildings; canopy offers virtually no protection; wind flow is systematic in disturbing everything in its path.

Source: Fire Behavior Field Reference

Relative Humidity - 1400-5000' Elevation

DRY BULB	WET BULB DEPRESSION, DEGREES F.															
	1°F	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
34	91 82 73 64	55 46 38 30	21 13 5													
35	91 82 74 65	56 48 40 32	24 16 8 0													
36	91 83 75 66	58 50 42 34	26 18 10 3													
37	92 84 75 67	59 51 43 35	28 20 13 5													
38	92 84 76 68	61 53 45 37	30 22 15 8													
39	92 84 76 69	62 54 47 39	32 24 17 10													
40	92 84 77 69	62 55 48 41	33 26 19 13													
41	92 85 77 70	63 56 49 42	35 28 22 15	8 2												
42	92 85 78 71	64 57 50 44	37 30 24 17	11 4												
43	92 86 78 71	65 58 51 45	38 32 26 19	13 7 1												
44	93 86 79 72	66 59 52 46	40 33 27 21	15 9 3												
45	93 86 79 72	66 60 53 47	41 35 29 23	17 11 5												
46	93 86 80 73	67 60 54 48	42 36 30 24	19 13 8 2												
47	93 86 80 74	67 61 55 49	43 37 32 26	20 15 10 4												
48	93 87 80 74	68 62 56 50	44 39 33 27	22 17 11 6												
49	93 87 81 74	69 63 57 51	45 40 34 29	24 18 13 8												
50	94 87 81 75	69 63 57 52	46 41 35 30	25 20 15 10												
51	94 88 82 76	70 64 58 53	47 42 37 31	26 21 17 12	7 2											
52	94 88 82 76	70 65 59 53	48 43 38 33	28 23 18 13	9 4											
53	94 88 82 76	71 65 60 54	49 44 39 34	29 24 20 15	10 6 2											
54	94 88 82 77	71 66 60 55	50 45 40 35	30 26 21 17	12 8 3											
55	94 88 82 77	72 66 61 56	51 46 41 36	31 27 23 18	14 9 5 1											
56	94 89 83 77	72 67 62 57	52 47 42 37	33 28 24 20	15 11 7 3											
57	94 89 83 78	72 67 62 57	52 48 43 38	34 30 25 21	17 12 8 4											
58	94 89 83 78	73 68 63 58	53 49 44 39	35 31 27 22	18 14 10 6											
59	95 89 84 78	74 68 64 59	54 49 45 40	36 32 28 24	19 15 11 8											
60	95 89 84 79	74 69 64 59	55 50 46 41	37 33 29 25	21 17 13 9											
61	95 90 84 79	74 69 65 60	55 51 46 42	38 34 30 26	22 18 14 11	7 3										
62	95 90 84 79	75 70 65 61	56 52 47 43	39 35 31 27	23 19 16 12	8 5 1										
63	95 90 85 80	75 70 66 61	57 52 47 44	40 36 32 28	24 21 17 13	10 6 3										
64	95 90 85 80	75 71 66 62	57 53 49 45	41 37 33 29	26 22 18 15	11 8 5 1										
65	95 90 85 80	76 71 67 62	58 54 50 46	42 38 34 30	27 23 19 16	12 9 6 3										
66	95 90 85 81	76 72 67 63	59 54 50 46	42 39 35 31	28 24 21 17	14 11 7 4	1									
67	95 90 85 81	76 72 68 63	59 55 51 47	43 40 36 32	29 25 22 18	15 12 9 6	3									
68	95 90 86 81	77 72 68 64	60 56 52 48	44 40 37 33	30 26 23 20	16 13 10 7	4 1									
69	95 91 86 81	77 73 69 64	60 56 52 49	45 41 38 34	31 27 24 21	17 14 11 8	5 2									
70	95 91 86 82	77 73 69 65	61 57 53 49	46 42 39 35	32 28 25 22	19 16 13 10	7 4 1									
71	95 91 86 82	77 73 69 65	61 57 54 50	46 43 39 36	32 29 26 23	20 17 14 11	8 5 2									
72	95 91 86 82	78 74 70 66	62 58 54 50	47 44 40 37	33 30 27 24	21 18 15 12	9 6 4 1									
73	95 91 87 82	78 74 70 66	62 59 55 51	48 44 41 38	34 31 28 25	22 19 16 13	10 8 5 2									
74	95 91 87 83	78 74 70 66	63 59 55 52	48 45 42 38	35 32 29 26	23 20 17 14	12 9 6 4									
75	95 91 87 83	79 75 71 67	63 59 56 52	49 46 42 39	36 33 30 27	24 21 18 15	13 10 7 5									
76	96 91 87 83	79 75 71 67	64 60 56 53	50 46 43 40	37 34 30 27	25 22 19 16	14 11 9 6	4 1								
77	96 91 87 83	79 75 71 68	64 60 57 53	50 47 44 40	37 34 31 28	25 23 20 17	15 12 10 7	5 2								
78	96 91 87 83	79 75 72 68	64 61 58 54	51 47 44 41	38 35 32 29	26 24 21 18	16 13 11 8	6 4 1								
79	96 92 88 84	80 76 72 68	65 61 58 54	51 48 45 42	39 36 33 30	27 25 22 19	17 14 12 9	7 5 2								
80	96 92 88 84	80 76 72 69	65 62 58 55	52 49 45 42	39 36 34 31	28 26 23 20	18 15 13 10	8 6 4								
82	96 92 88 84	80 77 73 69	66 62 59 56	53 50 47 44	41 38 35 32	30 27 24 22	20 17 15 12	10 8 6								
84	96 92 88 84	81 77 74 70	67 63 60 57	54 51 48 45	42 39 36 34	31 29 26 24	21 19 17 14	12 10 8								
86	96 92 88 85	81 77 74 71	67 64 61 58	55 52 49 46	43 40 38 35	33 30 28 25	23 21 18 16	14 12 10								
88	96 92 89 85	81 78 75 71	68 65 62 59	56 53 50 47	44 42 39 36	34 31 29 27	24 22 20 18	16 14 12								
90	96 92 89 85	82 78 75 72	68 65 62 59	56 54 51 48	45 43 40 38	35 33 30 28	26 24 21 19	17 15 13								
92	96 92 89 85	82 79 75 72	69 66 63 60	57 54 52 49	46 44 41 39	36 34 32 29	27 25 23 21	19 17 15								
94	96 93 89 86	82 79 76 73	69 66 64 61	58 55 52 50	47 45 42 40	37 35 33 31	28 26 24 22	20 18 16								
96	96 93 89 86	83 79 76 73	70 67 64 61	59 56 53 51	48 46 43 41	38 36 34 32	30 28 26 24	22 20 18								
98	96 93 90 86	83 80 77 74	71 68 65 62	59 57 54 51	49 46 44 42	39 37 35 33	31 29 27 25	23 21 19								
100	96 93 90 86	83 80 77 74	71 68 65 62	60 57 55 52	49 47 45 43	40 38 36 34	32 30 28 26	24 22 21								
102	97 93 90 87	83 80 77 74	71 69 66 63	61 58 55 53	50 48 46 44	41 39 37 35	33 31 29 27	25 23 22								
104	97 93 90 87	84 81 78 75	72 69 66 64	61 59 56 54	51 49 47 44	42 40 38 36	34 32 30 28	26 25 23								
106	97 93 90 87	84 81 78 75	72 70 67 64	62 59 57 54	52 50 47 45	43 41 39 37	35 33 31 29	28 26 24								
108	97 93 90 87	84 81 78 75	73 70 67 65	62 60 57 55	53 50 48 46	44 42 40 38	36 34 32 30	29 27 25								
110	97 94 90 87	84 81 79 76	73 70 68 65	63 60 58 56	53 51 49 47	45 43 41 39	37 35 33 31	29 28 26								

1. Find current dry bulb reading in left column.
2. For wet bulb depression on top-subtract wet bulb reading from dry bulb reading.
3. Read RH% where they intersect.

WET BULB DEPRESSION, DEGREES F.
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Hazard Tree Safety

Environmental conditions that increase snag hazards:

- Strong winds
- Night operations
- Steep slopes
- Diseased or bug-kill areas

Hazard tree indicators:

- Trees have been burning for any period of time
- High risk tree species (rot and shallow root system)
- Numerous downed trees
- Dead or broken tops and limbs overhead
- Accumulation of downed limbs
- Absence of needles, bark or limbs
- Leaning or hung-up trees

In addition to suppression and mop-up operations, assess hazard trees when you take breaks and choose campsites.

Procedural Chain Saw Operations

Procedural approach to cutting operations begins with assessing the situation, completing a hazard analysis, and establishing cutting area control.

Situational Assessment

- Observe tree characteristics
- Determine soundness or defects
- Analyze the tree base
- Check surrounding terrain
- Examine work area

Hazard Analysis

- Overhead hazards
- Ground hazards
- Environmental hazards
- Mental and physical hazards

Felling Operation Controls

- Establish a lookout to observe the tree at all times.
- Check for nearby hazard trees
- Assess lean(s) & lay
- Swamp out base
- Brief swamper
- Face tree with adequate stump shot
- Give warning yell
- Look up while cutting
- Complete back cut
- Use wedging procedure
- Use escape route and safe zones
- Analyze stump

Line Spike

The “Line Spike,” or “Coyote,” is a progressive line construction technique in which self-sufficient crews build fireline until the end of an operational period, remain overnight (RON) at or near that point, and then begin again the next operational period. Crews should be properly equipped and prepared to spend two or three shifts on the line with minimal support from the incident base.

Safety Considerations

- Can line spike locations maintain LCES at all times?
- Can emergency medical technicians be on the line?
- Can a timely medevac plan be implemented?
- Can daily communications (verbal and written) be maintained?
- Can food and water be provided daily?
- Is each crew boss comfortable with the assignment?

Operational Considerations

- Meals during line spike operational periods may consist of rations and/or sack lunches.
- The line spike generally will not last more than two or three operational periods for any one crew.
- Division Supervisors will be responsible for establishing on and off operational period times.
- Crews working line spike operational periods will be resupplied on the fireline as close as possible to the RON point.

Logistical Considerations:

- Bringing toothbrush/paste, extra socks/underwear, light coat, double lunch, space blanket, etc.
- Considering early in the operational period where the crew(s) will RON, and that the location provides for safety and logistical needs of the crew (main fire poses no threat, helicopters can long-line or land at site, personnel are provided semi-flat ground to sleep on, adequate firewood exists for warming fires, etc.).
- Anticipating resupply needs and placing those orders early in the operational period. Crew leaders should make arrangements to have qualified individuals at RON locations to accept those orders by long-line or internal helicopter operations.
- Taking measures to prevent problems with food, trash, etc. in areas where bears are a concern. It's a common practice to leave one or more individuals with radio communications at the RON location to coordinate the "back haul" of trash or the pre-positioning of reusable supplies to advanced RON locations.
- How crew time and commissary items will be managed. Normally this function can be provided by using in-/out-bound helicopter flights at the RON location, or the time is turned in upon returning to the incident base.
- How medical emergencies will be managed. An emergency medical technician may be needed at the RON location.

Minimum Impact Suppression Tactics

The intent of minimum impact suppression tactics is to suppress a wildfire with the least impact to the land. Fire conditions and good judgment dictate the actions taken. Consider what is necessary to halt fire spread and contain it within the fireline or designated perimeter boundary.

A. Safety

- Safety is of utmost importance.
- Constantly review and apply the “Watch Out Situations” and “Firefighting Orders.”
- Be particularly cautious with:
 - Unburned fuel between you and the fire.
 - Burning snags allowed to burn.
 - Burning or partially burned live and dead trees.
- Be constantly aware of surroundings, expected fire behavior, and possible fire perimeter 1 or 2 days hence.

B. Fire Lining Phase

- Select procedures, tools, equipment that least impact the environment.
- Seriously consider using water as a firelining tactic (fireline constructed with nozzle pressure, wetlining).
- In light fuels, consider:
 - Cold-trail line.
 - Allowing fire to burn to natural barrier.

- Burning-out and use of gunnysack or swatter.
 - Constantly rechecking cold-trailed fireline.
 - If constructed fireline is necessary, using minimum width and depth to check fire spread.
- **In medium/heavy fuels, consider:**
 - Using natural barriers and cold-trailing.
 - Cooling with dirt and water, and cold-trailing.
 - If constructed fireline is necessary, using minimum width and depth to check fire spread.
 - Minimizing bucking to establish fireline. Preferably move or roll downed material out of the intended constructed fireline area. If moving or rolling out is not possible, or the downed log/bole is already on fire, build line around and let material be consumed.
- **Aerial fuels -- brush, trees, and snags:**
 - Adjacent to fireline: Limb only enough to prevent additional fire spread.
 - Inside fireline: Remove or limb only those fuels that if ignited would have potential to spread fire outside the fireline.
 - Brush or small trees that are necessary to cut during fireline construction will be cut flush with the ground.

- **Trees, burned trees, and snags:**
 - MINIMIZE cutting of trees, burned trees, and snags.
 - Live trees will not be cut, unless determined they will cause fire spread across the fireline or endanger workers. If tree cutting occurs, cut the stumps flush with the ground.
 - Scrape around tree bases near fireline if hot and likely to cause fire spread.
 - Identify hazardous trees with either an observer, flagging, and/or glow-sticks.

- **When using indirect attack:**
 - Do not fall snags on the intended unburned side of the constructed fireline, unless they are a safety hazard to crews.
 - On the intended burn-out side of the line, fall only those snags that would reach the fireline should they burn and fall over. Consider alternative means to falling (fireline explosives, bucket drops).
 - Review items listed above (aerial fuels, brush, trees, and snags).

C. Mop-Up Phase

- **Consider using “hot-spot” detection devices along perimeter (aerial or hand-held).**
- **Light fuels:**
 - Cold-trail areas adjacent to unburned fuels.
 - Do minimal spading; restrict spading to hot areas near fireline.

- Use extensive cold-trailing to detect hot areas.
- **Medium and heavy fuels:**
 - Cold-trail charred logs near fireline; do minimal scraping or tool scarring.
 - Minimize bucking of logs to check for hot spots or extinguish fire; preferably roll the logs and extinguish the fire.
 - Return logs to original position after checking or ground is cool.
 - Refrain from making boneyards; burned/partially burned fuels that were moved should be arranged in natural position as much as possible.
 - Consider allowing larger logs near the fireline to burnout, instead of bucking into manageable lengths. Use lever, etc., to move large logs.
- **Aerial fuels – brush, small trees, and limbs.**
 - Remove or limb only those fuels that if ignited, have potential to spread fire outside the fireline.
- **Burning trees and snags.**
 - See Section B

Sustained Line Production Rates of 20-Person Crews for Construction, Burnout, and Holding in Chains/Hour

	Fire Behavior Fuel Model	Specific Conditions	Crew Type	
			Type I	Type II
1	Short Grass	Grass Tundra	30 9	18 5
2	Open Timber/ Grass Understory	All	24	16
3	Tall Grass	All	5	3
4	Chaparral	Chaparral High Pocosin	5 4	3 2
5	Brush	All	6	4
6	Dormant Brush/ Hardwood Slash	Black Spruce Others	7 6	5 4
7	Southern Rough	All	4	2
8	Closed Timber Litter	Conifers	7 40	5 24
9	Hardwood Litter	Conifers Hardwoods	28 40	16 24
10	Timber (Litter & Understory)	All	6	4
11	Logging Slash, Light	All	15	9
12	Logging, Slash Medium	All	7	4
13	Logging Slash, Heavy	All	5	3

NOTE: Allowances have been made in production rates for rest periods and cumulative fatigue.

Dozer Fireline Construction Rates for Single Pass in Chains/Hour

NOTE: Prediction rates vary with conditions. The higher rate can be used for newer dozers (1975 and later).

Fire Behavior Fuel Model	Up or Down Slope	Slope Class			
		1 0-25%	2 26-40%	3 41-55%	4 56-74%
Type III Dozer 1,2	Up	55-90	30-55	8-30	0-8
	Down	90-110	90-110	20-90	0-20
3,5,8	Up	45-70	25-45	2-25	0-2
	Down	70-80	65-80	0-65	0
4.00	Up	20-35	10-20	0-10	0
	Down	35-40	25-40	0-25	0
6,7,9	Up	35-55	15-35	0-15	0
	Down	55-60	40-60	0-40	0
11,12	Up	15-25	7-15	0-7	0
	Down	25-30	10-30	0-10	0
10,13	Up	8-15	3-8	0-3	0
	Down	10-15	5-10	0-5	0
Type II Dozer 1,2	Up	85-125	60-85	30-60	0-30
	Down	125-145	130-145	75-130	0-75
3,5,8	Up	70-105	45-70	15-45	0-15
	Down	105-120	105-120	55-105	0-55
4.00	Up	35-60	20-35	2-20	0-2
	Down	60-75	65-76	20-65	0-20
6,7,9	Up	50-85	30-50	7-30	0-7
	Down	85-100	85-100	40-85	0-40
11,12	Up	25-40	15-25	1-15	0-1
	Down	40-55	45-55	0-45	0
10,13	Up	10-20	7-10	0-7	0
	Down	20-25	20-25	0-20	0
Type I Dozer 1,2	Up	100-140	70-100	35-70	0-35
	Down	140-155	140-155	85-140	0-85
3,5,8	Up	75-110	50-75	20-50	0-20
	Down	110-130	110-130	55-110	0-55
4.00	Up	45-70	30-45	8-30	0-8
	Down	70-80	75-85	25-75	0-25
6,7,9	Up	65-95	40-65	15-40	0-15
	Down	95-110	90-110	50-90	0-50
11,12	Up	35-55	20-35	3-20	0-3
	Down	55-65	55-65	6-55	0-6
10,13	Up	20-35	9-20	0-9	0
	Down	35-40	30-40	0-30	0

Tractor-Plow Fireline Production Rates In Chains Per Hour

(drag or mounted plow, appropriate blade, level to rolling terrain)

Fire Behavior Fuel Model	Tractor Plow Type					
	1	2	3	4	5	6
	(165 HP) D-7, JD-850 TD-20 & Larger	(140 HP) D-6, JD-750, TD-15, Case 1450	(120 HP) D5H, D4H, TD-12, Case 1150	(90HP) D-4, JD-650, TD-9, D5C	(70-80 HP) JD450, D4C, TD-8	(42-60 HP) JD350, D3, JD-400, TD-7
1	240	240	240	200	180	80
2	180	180	180	140	120	80
3	180	180	180	120	100	70
4	80	80	60	40	20	0
5	160	160	160	100	80	40
6	120	120	100	60	40	20
7	160	160	160	120	100	60
8	180	180	180	120	100	70
9	180	180	180	120	100	70
10	100	100	80	50	40	20
	Mountainous Terrain, 60% or less slope, front and rear mounted plow, downhill plowing					
8	--	--	--	50	40	20
9	--	--	--	50	40	20
	Mountainous terrain, 60% or less slope, using ripper attachment, up/down slope fireline construction					
1, 2, 3	20/30	10/30	0/30	--	--	--
4, 6, 12, 13	10/20	5/10	0/5	--	--	--
5, 7, 8-10, 11	12/25	8/15	0/10	--	--	--

*Minimum standards for personnel with dozers may differ depending on fuel type, terrain, and resource configuration. Dozer strike teams may use team leader in place of additional personnel per dozer. Fuel requiring burnout and terrain that requires scouting demands two personnel per dozer.

Dozer Use Hand Signals



STOP - Back and forth, waist high, swinging motion.



COME AHEAD - Up and down in front of spotter, from waist to arm's length above head.



TURN - Swing flag or light on side to which operator is to turn.



REVERSE OR BACKUP - Full circle in front of the spotter.



CAUTION - Wave flag or light in half circle at arm's length above head.



ATTRACT OPERATOR'S ATTENTION - May also use one blast on a whistle, horn, or other suitable device.



SIGNALS GIVEN BY OPERATOR

- **CAN'T SEE SPOTTER** - Gun motor twice.
- **WANT DOZER HELPER TO COME TO DOZER** - Gun motor once.

Water Delivery Information

GPM for nozzles

Forester	3/16 tip: 10 gpm (50 psi nozzle pressure)
	3/8 tip: 30 gpm (50 psi nozzle pressure)
Variable Pattern	One inch: 20 gpm (100 psi nozzle pressure)
	1½ inch: 60 gpm (100 psi nozzle pressure)

Maximum efficient flow

One inch hose: 30 gpm
1½ inch hose: 100 gpm

Useful Information

- Test for flow (gpm) by time required to fill a fedco (5 gal. in 15 sec.=20 gpm)
- Maximum vertical height for drafting = 12 ft. (Mark 3)
- Loss of one foot draft per 1000 feet elevation
- Head pressure loss or gain: 5 psi per 10 feet elevation
- Friction loss for one inch hose:
 - 10 gpm = 4 psi per 100 ft.
 - 20 gpm = 12 psi per 100 ft.
 - 30 gpm = 26 psi per 100 ft.
- Friction loss for 1½" hose:
 - 10 gpm = 5 psi per 100 ft.
 - 20 gpm = 2 psi per 100 ft.
 - 30 gpm = 4 psi per 100 ft.
 - 60 gpm = 13 psi per 100 ft.
- Use check valve for pumping uphill to overcome back pressure at pump.
- Avoid use of hard suction for tandem pumping. Not designed to withstand positive pressures.
- Pump pressure = nozzle pressure + friction loss of hoselay ± head pressure + appliance friction loss.
- A double hose lay will reduce friction loss 1/4 of a single hoselay.
- Friction loss for gated wye: 5 psi
- Use of two suction hoses on intake will increase gallons per minute.
- Maximum horizontal distance-pumping
Single Mark 3 pump, 1½" hose, 50 psi nozzle pressure
 - 10 gpm: 40,000 ft.
 - 20 gpm: 10,000 ft.
 - 30 gpm: 4,000 ft.
 - 60 gpm: 800 ft.
- Maximum vertical distance-pumping
Single Mark 3 pump, 1½" hose, 50 psi nozzle pressure
 - 10 gpm: 400 ft. (Friction loss for hose not included)
 - 20 gpm: 400 ft.
 - 30 gpm: 350 ft.
 - 60 gpm: 200 ft.

GALLONS OF WATER

	5	10	50	100	150	200	250	300	350	400	450	500
1.0	6 OZ	13 OZ	0.5 GAL	1.0 GAL	1.5 GAL	2.0 GAL	2.5 GAL	3.0 GAL	3.5 GAL	4.0 GAL	4.5 GAL	5.0 GAL
.9	5.5 OZ	12 OZ	58 OZ	0.9 GAL	1.4 GAL	1.75 GAL	2.25 GAL	2.75 GAL	3.0 GAL	3.5 GAL	4.0 GAL	4.5 GAL
.8	5 OZ	10 OZ	51 OZ	0.8 GAL	1.2 GAL	1.6 GAL	2.0 GAL	2.5 GAL	2.75 GAL	3.0 GAL	3.5 GAL	4.0 GAL
.7	4.5 OZ	9 OZ	45 OZ	89 OZ	1.0 GAL	1.5 GAL	1.75 GAL	2.0 GAL	2.5 GAL	2.75 GAL	3.0 GAL	3.5 GAL
.6	4 OZ	8 OZ	38 OZ	76 OZ	0.9 GAL	1.25 GAL	1.5 GAL	1.75 GAL	2.0 GAL	2.5 GAL	2.75 GAL	3.0 GAL
.5	3 OZ	6 OZ	32 OZ	0.5 GAL	.75 GAL	1.0 GAL	1.25 GAL	1.5 GAL	1.75 GAL	2.0 GAL	2.25 GAL	2.5 GAL
.4	2.5 OZ	5 OZ	26 OZ	51 OZ	76 OZ	0.8 GAL	1.0 GAL	1.2 GAL	1.4 GAL	1.6 GAL	1.8 GAL	2.0 GAL
.3	2 OZ	4 OZ	19 OZ	38 OZ	58 OZ	76 OZ	.75 GAL	0.9 GAL	1.0 GAL	1.2 GAL	1.3 GAL	1.5 GAL
.2	1 OZ	2.5 OZ	13 OZ	25 OZ	38 OZ	51 OZ	0.5 GAL	76 OZ	89 OZ	0.8 GAL	0.9 GAL	1 GAL
.1	0.5 OZ	1 OZ	6 OZ	13 OZ	19 OZ	25 OZ	32 OZ	38 Z	45 OZ	51 OZ	58 OZ	0.5 GAL

Foam Concentrate to Add

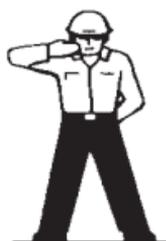
F
O
A
M
%

One gallon (GAL) is equal to 128 ounces (OZ) and one quart is equal to 32 ounces.

Wildland Water Use Hand Signals



How full is tank?



Full



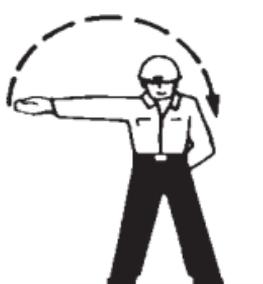
Half full



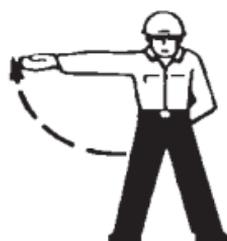
Low



Deliver Water



Increase pressure



Decrease pressure



More hose



Broken hose



Shut down



Roll up hose

Average Perimeter in Chains

Acres	Perimeter	Acres	Perimeter
1	17	100	170
2	24	150	200
3	29	200	240
4	34	300	300
5	38	400	350
7	45	500	375
10	53	600	425
15	65	700	450
20	75	800	475
25	85	900	500
30	90	1,000	525
40	105		
50	120		
75	150		

One chain = 66 feet

Fire Size Class

<u>Class</u>	<u>Size</u>
A	0 - 1/4 acre
B	1/4 - 10 acres
C	10 - 99 acres
D	100 - 299 acres
E	300 - 999 acres
F	1000 - 4999 acres
G	5000+ acres

Fire Cause Determination Checklist

- Take essential investigation materials to the incident.
- Make notes of all your actions and findings including:
 - Time fire was reported.
 - Name and identification of reporting party.
 - En route observations - people and vehicles.
 - Name and identification of persons or vehicles in vicinity of fire origin.
 - Record the weather.
- Locate and protect fire origin.
- Search fire origin area for physical evidence of fire cause.
- Protect evidence. **Do not remove** unless necessary to prevent destruction.
- Make sketches of origin area with measurements of relative locations of all evidence.
- Take photographs from all angles including long and medium distance, and close-up views of fire origin area and evidence.
- Turn over all notes, information, and physical evidence to the responsible law enforcement representative, or make your notes part of the official fire record.

Media Interviews

- Prepare. Know the facts. Develop 2-3 key messages and deliver them. Prepare responses to potential tough questions. If possible, talk to reporter beforehand to get an idea of subjects, direction and slant of the interview.
- Be concise. Give 10-20 second, simple answers, and when you're done, be quiet. If you botch the answer, simply ask to start again.
- Be honest, personable, professional, presentable (remove sunglasses and hats).
- Look at the reporter, not the camera.
- Ensure media are escorted and wearing PPE when going to the fireline or hazardous sites.
- Ensure local Public Affairs office is aware of media visits.
- NEVER talk "off the record," exaggerate, or try to be cute or funny.
- DON'T guess or speculate or say "no comment." Either explain why you can't answer the question or offer to track down the answer.
- DON'T disagree with the reporter. Instead, tactfully and immediately clarify and correct the information.
- DON'T speak for other agencies or offices; or use jargon or acronyms.

Phonetic Alphabet

	Law Enforcement	International
A	Adam	Alpha
B	Boy	Bravo
C	Charles	Charlie
D	David	Delta
E	Edward	Echo
F	Frank	Foxtrot
G	George	Golf
H	Henry	Hotel
I	Ida	India
J	John	Julliett
K	King	Kilo
L	Lincoln	Lima
M	Mary	Mike
N	Nora	November
O	Ocean	Oscar
P	Paul	Papa
Q	Queen	Quebec
R	Robert	Romeo
S	Sam	Sierra
T	Tom	Tango
U	Union	Uniform
V	Victor	Victor
W	William	Whiskey
X	X-Ray	X-Ray
Y	Young	Yankee
Z	Zebra	Zulu

Radio Frequencies

SIMPLEX	REPEAT	TONE

Radio Frequencies

SIMPLEX	REPEAT	STONE

Contact List/Phone Numbers

Position/Name	Agency	Phone#/ Radio Freq.
FIRE/CRASH RESCUE		
Fire Rescue		
MEDICAL		
Ambulance Air Ambulance Hospital Hospital Burn Center Poison Center		
LAW ENFORCEMENT		
Police Police Site Security		
ACCIDENT INVESTIGATION		
24-hr. Reporting Safety Mgr.		

BRIEFING CHECKLIST

Situation

- Fire name, location, map orientation, other incidents in area
- Terrain influences
- Fuel type and conditions
- Fire weather (previous, current, and expected)
Winds, RH, Temperature, etc.
- Fire behavior (previous, current, and expected)
Time of day, Alignment of slope and wind, etc.

Mission/Execution

- Command
Incident Commander / Immediate supervisor
- Leader's intent
Overall objectives / strategy
- Specific tactical assignments
- Contingency plans

Communications

- Communication plan
Tactical, Command, Air-to-ground frequencies
Cell phone numbers
- Medevac plan

Service / Support

- Other resources
Working adjacent and those available to order
Aviation operations
- Logistics
Transportation
Supplies and equipment

Risk Management

- Identify known hazards and risks
- Identify control measures to mitigate hazards / reduce risk
- Identify trigger points for re-evaluating operations

Questions or Concerns?

STANDARD FIREFIGHTING ORDERS

1. Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.
4. Identify escape routes and safety zones, and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively.
7. Maintain prompt communications with your forces, your supervisor and adjoining forces.
8. Give clear instructions and insure they are understood.
9. Maintain control of your forces at all times.
10. Fight fire aggressively, having provided for safety first.

WATCH OUT SITUATIONS

1. Fire not scouted and sized up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link with crew members or supervisor.
8. Constructing line without safe anchor point.
9. Building fireline downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and fire.
12. Cannot see main fire; not in contact with someone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather becoming hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across line.
17. Terrain and fuels make escape to safety zones difficult.
18. Taking a nap near fireline.

Glossary

Accreditation	A status granted to an educational institution or program that has been found to meet or exceed standard criteria of educational quality. Accreditation is voluntarily sought by institutions and programs and is conferred by non-governmental bodies. The accreditation process universally uses a common scope, whether international, national or regional. The process requires integral self-study of the institution program, followed by an on-site visit from an evaluation team and finally, a review for approval by central governing body.
Action Plan	<i>See Incident Action Plan.</i>
Adiabatic	Process of thermodynamic change of state in which no heat is added or subtracted from a system; compression always results in warming, expansion in cooling.
Adjustable Fog Nozzle	Nozzle designed to allow the discharge pattern to be adjusted from straight stream to full fan fog; suitable for applying water, wet water, or foam solution. Some adjustable fog nozzles allow the rate of flow to be adjusted as well.
Aeration	Introduction of air into a foam solution to create bubbles that result in finished foam.
Aerial Fuels	Standing and supported live and dead combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines.
Aerial Ignition	Use of an airborne incendiary device to assist in backfiring, burning out, or prescribed fires. Devices are normally carried in or suspended from helicopters.
Air Attack	Using fixed-wing aircraft or helicopters to apply fire retardants or extinguishing agents on a wildland fire. Aircraft can also be used to transport crews, supplies, and equipment or provide medical evacuation and reconnaissance.
Airdrop	Water, short-term fire retardant, or long-term fire retardant cascaded from an air tanker or helicopter.
Air Mass	Extensive body of air, usually 1,000 miles (1,600 km) or more across, having the same properties of temperature and moisture in a horizontal plane.
Air Support Group Supervisor	Individual responsible to the air operations branch director for logistical support and management of helibase and helispot operations and maintenance at fixed-wing aircraft bases.
Air Tactical Group Supervisor	Individual responsible to the air operations branch director for the coordination of fixed-wing and/or rotary-wing aircraft operations over an incident.
Air Tanker	Fixed-wing aircraft used to drop retardant or water during an air attack.
Anchor Point	Point from which a fireline is begun; usually a natural or man-made barrier that will prevent fire spread and the possibility of a crew being “flanked” while constructing the fireline. Typical anchor points are roads, lakes, ponds, streams, earlier burns, rock slides, and cliffs.
Angle of Approach	On a vehicle, the smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the apparatus ahead of the front axle—the front overhang.
Angle of Departure	On a vehicle, the smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the apparatus behind the rear axle—the rear overhang.
Apparatus	Motor-driven vehicle or group of vehicles designed and constructed for the purpose of fighting fires; may be of different types such as engines, water tenders, and ladder trucks.
Area Ignition	Ignition or nearly simultaneous ignition of several individual fires that influence the main fire and each other in a way that produces a hot, fast-moving fire or blowup throughout the area.
Arson	Crime of maliciously and intentionally starting a fire or causing an explosion. Precise legal definitions vary among jurisdictions, wherein it is defined by statutes and judicial decisions.
Ash	Powdery residue left when organic material is burned completely or is oxidized by chemical means.
Aspect	Compass direction toward which a slope faces.
Atmospheric Pressure	Force exerted by the weight of the atmosphere per unit area.

Atmospheric Stability	Degree to which vertical motion in the atmosphere is enhanced or suppressed. Vertical motions and smoke dispersion are enhanced in an unstable atmosphere. Stability suppresses vertical motion and limits smoke dispersion.— <i>Also see</i> Inversion.
Attack Line	Hoseline connected to a pump discharge of a fire apparatus ready for use in attacking a fire (may or may not be preconnected); contrasted to supply lines connecting a water supply with a pump.
Automatic Aid	Written agreement between two or more agencies to automatically dispatch predetermined resources to any fire or other emergency reported in the geographic area covered by the agreement. These areas are generally where the boundaries between jurisdictions meet or where jurisdictional “islands” exist.
Backfire	Fire set along the inner edge of a control line to consume the fuel in the path of a wildland fire and/or change the direction of force of the fire’s convection column.
Backfiring	Offensive tactic associated with indirect attack; intentionally setting fire to fuels inside the control line to slow, knock down, or contain a rapidly spreading fire. The intent is for the backfire to meet the advancing fire some distance from the control line. Backfiring provides a wide defense perimeter and may be further employed to change the force of the convective column; makes possible a strategy of locating control lines at places where the fire can be fought on the firefighter’s terms.
Backing Fire	Fire spreading (or ignited to spread) into (against) the wind or downslope. A fire spreading on level ground in the absence of wind is a backing fire.
Baffle	Partition placed in vehicular or aircraft water tanks to reduce shifting of the water load when starting, stopping, or turning.
Barrier	Any obstruction of the spread of fire; typically an area or strip devoid of combustible fuel.
Base Radio	Powerful communications equipment—similar to that used in agency dispatch centers—normally used at a fixed location such as an Incident Command Post.
Batch-Mixing	Making of foam solution by pouring an appropriate amount of foam concentrate into a water tank.
Belt Weather Kit	Belt-mounted case with pockets fitted for anemometer, compass, sling psychrometer, slide rule, water bottle, pencils, and book of weather report forms.
Berm	Outside or downhill side of a ditch or trench; a mound or wall of earth.
Black	Area already burned by a wildland fire. Also called Burn.
Blacklining	Ensuring that there are no unburned fuels adjacent to the control line by burning out such areas; burning out adjacent to a control line to widen and strengthen it.
Blowup	Sudden dangerous increase in fireline intensity typically caused by strong or erratic wind, steep slopes, large open areas, and easily ignited fuels. Blowup is sufficient to preclude direct attack or to change the incident action plan; often accompanied by violent convection and may have other characteristics of a fire storm. <i>Also see</i> Flare-Up.
Boneyarding	During mop-up, spreading materials that are no longer burning in an area within the black that has been cleared of all burning or hot fuels.
Booster Line	Noncollapsible rubber-covered, rubber-lined hose usually wound on a reel and mounted somewhere on an engine or water tender. This hose is most commonly found in 1/2-, 3/4-, and 1-inch (13 mm, 19 mm, and 25 mm) diameters and is used for extinguishing low-intensity fires and mop-up. Also called Hard Line.
Breakover	<i>See</i> Sloper.
Breakover Angle	Angle formed by a line from the point of contact of the rear tire with the ground and the chassis midpoint.
British Thermal Unit (Btu)	Amount of heat energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit. One Btu = 1.055 kilojoules (kJ).
Brush	Collective term that refers to stands of vegetation dominated by shrubby, woody plants or low-growing trees, usually of a type undesirable for livestock or timber management.

Brush Hook	Heavy cutting tool designed primarily to cut brush at the base of the stem; used in much the same way as an axe; has a wide blade generally curved to protect the blade from being dulled by rocks.
Brush Truck	An off road vehicle used to carry water (usually 500 gallons or less) into remote areas or rough terrain that engines cannot access. Usually equipped with a variety of wildland hand tools.
Bulldozer	Any tracked vehicle with a blade for exposing mineral soil. Also called Dozer. <i>Also see</i> Dozer Tender and Dozer Transport.
Burn	<i>See</i> Black.
Burning Out	Setting fire inside a control line to consume fuel between the edge of the fire and the control line. Burning out is done on a small scale in order to consume unburned fuel and aid control line construction. Burning out should not be confused with “backfiring,” which is a larger-scale tactic to eliminate large areas of unburned fuels in the path of a fire or to change the direction of force of a convection column.
CAFS	Abbreviation for Compressed Air Foam System.
Canopy	Level or area containing the crowns of the tallest vegetation present (living or dead), usually above 20 feet (6 m).
Cavitation	Condition in which vacuum bubbles form in a pump and cause vibration, loss of efficiency, and possibly damage.
Centrifugal Pump	Pump with one or more impellers that utilizes centrifugal force to move the water.
Char	Carbonaceous material formed mainly on the surface of organic matter, commonly wood, that has not burned completely; the solid remains of burned organic material.
Check-In	Process or location used by assigned resources to report in at an incident.
Chimney	Steep, narrow draws or canyons in which heated air rises rapidly as it would in a flue pipe.
Class A Foam	Foam specially designed for use on Class A combustibles; hydrocarbon-based surfactant, essentially a wetting agent that reduces the surface tension of water and allows it to soak into combustible materials easier than plain water.
Class A Fuels	Ordinary combustible solids such as wood, grass, rubber, cloth, paper, and plastics.
Clear Text	Use of plain English, including certain standard words and phrases, in radio communications transmissions.
Cold Front	Leading edge of a relatively cold air mass that displaces and may cause warmer air to rise. If the lifted air contains enough moisture, cloudiness, precipitation, and even thunderstorms may result. As fronts move through a region, the winds at a given location experience a marked shift in direction.
Cold Trailing	Method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand to detect any fire, digging out every live spot, and trenching any live edge; done to ensure no further advance of a fire.
Combination Nozzle	Nozzle designed to provide either a solid stream or a fixed spray pattern suitable only for mop-up. Not to be confused with an adjustable fog nozzle.
Combustion	Self-sustaining process of rapid oxidation of a fuel that produces heat and light.
Command	(1) Act of directing and/or controlling resources by virtue of explicit legal, agency, or delegated authority. (2) Term used on the radio to designate the incident commander.
Command Post	<i>See</i> Incident Command Post.
Compressed Air Foam System (CAFS)	Generic term used to describe foam-generation systems consisting of an air compressor (or other air source), a water pump, and foam solution.
Conduction	Transfer of heat energy from one body to another through direct contact or an intervening medium from a region of high temperature to a region of low temperature.
Confine a Fire	To restrict the fire within determined boundaries established either prior to the fire or during the fire. Also called Confinement.
Confinement	<i>See</i> Confine a Fire.

Contain a Fire	To take suppression action that can reasonably be expected to check the fire spread under prevailing and predicted conditions. Also called Containment.
Contained Fire	The status of a wildfire suppression action signifying that a control line has been completed around the fire, and any associated spot fires, which can reasonably be expected to stop the fire's spread.
Containment	<i>See</i> Contain a Fire.
Continuous Fuels	Fuels distributed uniformly over an area, thereby providing a continuous path for fire to spread. <i>Also see</i> Fuel Continuity.
Control	Point in time when the perimeter spread of a wildland fire has been halted and can reasonably be expected to hold under foreseeable conditions.
Control a Fire	To complete control line around a fire, any spot fire from the fire, and any interior island to be saved; to burn out any unburned area adjacent to the fire side of the control lines; and to cool down all hot spots that are immediate threats to the control line until the lines can reasonably be expected to hold under foreseeable conditions.
Controlled Burning	Fires intentionally set in vegetative fuels for the purpose of burning debris or accumulations of wildland fuels; may be done as part of a fuel-management program to prevent or reduce the rate of spread of wildland fires. <i>Also see</i> Prescribed Burning.
Control Line	Inclusive term for all constructed or natural barriers and treated fire edges used to control a fire.
Convection	Transfer of heat by the movement of fluids or gases, usually in an upward direction.
Convection Column	Rising column of heated air or gases above a continuing heat or fire source.
Cooperative Agreement	Written agreement between fire protection agencies agreeing to cooperate in actions or share resources for a common good.
Creeping Fire	Fire burning with a low flame height and spreading slowly.
Crew	Organized group of firefighters under the leadership of a crew leader or other designated supervisor; sometimes referred to as a "company" in municipal fire departments.
Crown Fire	Fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.
Crown Out	Fire that rises from ground level into the tree crowns and advances from treetop to treetop.
Cumulonimbus Clouds	Ultimate growth of a cumulus cloud into an anvil-shaped cloud with considerable vertical development, usually with fibrous ice crystal tops, and usually accompanied by lightning, thunder, hail, and strong winds.
Cumulus Clouds	Principal low-cloud type in the form of individual cauliflower-like cells of sharp nonfibrous outline and less vertical development than cumulonimbus clouds.
DBH	Abbreviation for Diameter at Breast Height.
Dead Fuels	Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.
Defensive Strategy	Defending exposed life, property, and resources in the path of a fire (as opposed to offensive strategies such as flanking, pincer, backfiring, etc.).
Diameter at Breast Height (DBH)	Means by which the relative size of trees is expressed. If a tree trunk measured at breast height is 20 inches (508 mm) or more in diameter, it is considered a large tree. A tree with a DBH of less than that is considered a small tree.
Direct Attack	To attack a wildland fire directly at the burning edge.
Diurnal	Daily; especially pertaining to cyclic actions of the atmosphere that are completed within 24 hours and that recur every 24 hours.
Division/Group Assignment List	A list used on the fireground that identifies resources with active assignments in the Operations section. ICS Form 204 (<i>Division Assignment List</i>) can be used as the basis for this list.
Dozer	<i>See</i> Bulldozer.
Dozer Tender	Any ground vehicle (service unit) with personnel capable of maintenance, minor repairs, and limited fueling of bulldozers.

Dozer Transport	Heavy vehicle carrying bulldozer to incident.
Draft	Drawing water from static sources into a pump that is above the level of the water supply. This is done by removing the air from the pump and allowing atmospheric pressure to push water through a noncollapsible suction hose into the pump.
Drift Smoke	Smoke that has been transported from its point of origin and in which convective, columnar motion no longer dominates.
Drop Zone	Target area for air tankers, helicopters, and cargo dropping.
Dry Adiabatic Lapse Rate	Rate of decrease in temperature with height of a mass of dry air lifted adiabatically through an atmosphere in hydrostatic equilibrium.,
Dry Air Mass	Portion of the atmosphere that has a relatively low dew point temperature and where the formation of clouds, fog, or precipitation is unlikely.
Dry Hydrant	Permanently installed pipe that has pumping-engine suction connections installed at water sources to speed drafting operations.
Dry Thunderstorm	Storm, including lightning, during which little or no rain reaches the ground.
Duff	Partly decomposed and matted leaves, twigs, and bark beneath the litter of freshly fallen twigs, needles, and leaves.
Durable Agents	<i>See</i> Gelling Agents.
Dust Devil	<i>See</i> Whirlwind.
Eductor	Venturi device that uses water pressure to draw foam concentrate into a water stream for mixing; also enables a pump to draw water from an auxiliary source.
Environmental Lapse Rate	Rate of temperature change with elevation determined by the vertical distribution of temperature at a given time and place.
Escape Route	Pathway to safety. It can lead to an already burned area, a previously constructed safety area, a meadow that will not burn, or a natural rocky area that is large enough to take refuge without being burned. When escape routes deviate from a defined physical path, they must be clearly marked (flagged).
Expansion	Ratio of the volume of foam in its aerated state to the original volume of the nonaerated foam solution.
Exposure	(1) Property that may be endangered by a fire burning in another structure or by a wildland fire. (2) Direction in which a slope faces. (3) General surroundings of a site with special reference to its openness to winds and sunshine.
Extended-Attack Fire	Wildland fire that has not been contained or controlled by initial-attack forces and for which more fire fighting resources are arriving, en route, or being ordered by the incident commander; situation in which a fire cannot be controlled by initial-attack resources within a reasonable period of time.
Exterior Fire Protection	Protection of structures from the exterior with no interior fire fighting.
Fingers	Long, narrow extensions of a fire projecting from the main body.
Fire	Rapid oxidation of combustible materials accompanied by a release of energy in the form of heat and light.
Fire Behavior	Manner in which a fire reacts to the variables of fuel, weather, and topography.
Fire-Behavior Forecast	Prediction of probable fire behavior, usually prepared by a fire-behavior officer in support of fire-suppression or prescribed burning operations.
Firebreak	Any natural or constructed barrier that is devoid of vegetation and stops or slows the advance of a wildland fire.
Fire Curtain	Aluminized device on a rod designed to be unrolled to reflect radiant heat from operators or crew members on some apparatus, bulldozers, or tractor-plows.
Fire Edge	Boundary of a fire at a given moment.

Fire Front	Part of a fire within which continuous flaming combustion is taking place; assumed to be the leading edge of the fire perimeter. In surface fires, the fire front may be mainly smoldering combustion.
Fire Hazard Severity Rating System	System of adjectives used to describe fire danger to the public. Adjectives range from low to extreme.
Fireline	Part of a control line that is scraped or dug to mineral soil; also, a general term for the area where fire fighting activities are taking place, the wildland equivalent of the term "fireground" as used in structural fire fighting.
Fireline Intensity	Rate of heat energy released per unit time per unit length of fire front. Numerically, it is the product of the heat of combustion, quantity of fuel consumed in the fire front, and the rate of spread of a fire in Btu per second per foot (kilojoules per second per meter) of fire front.
Fire Plow	Heavy-duty plowshare or disc plow pulled by a tractor to construct a fireline.
Fire Prevention	All activities concerned with minimizing the incidence of fires.
Fire Protection	Actions taken to limit the adverse environmental, social, political, economic, and life-threatening effects of fire.
Fire Retardant	Any substance, except plain water, that reduces flammability of fuels or slows their rate of combustion by chemical or physical action.
Fire Season	Period(s) of the year during which fires are likely to occur, spread, and damage wildland values sufficient to warrant organized fire suppression.
Fire Shelter	Aluminized tent carried by firefighters offering personal protection by means of reflecting radiant heat and providing a volume of breathable air in a fire-entrapment situation.
Fire Storm	Violent convection caused by a large continuous area of intense fire; often characterized by destructively violent surface indrafts, near and beyond the perimeter, and sometimes by tornado-like whirls.
Fire Stream	Stream of water or other water-based extinguishing agent after it leaves the nozzle until it reaches the desired point.
Fire Suppressant	Any agent used to extinguish the flaming and smoldering phases of combustion by direct application to the burning fuel.
Fire Suppression	All work and activities connected with fire-extinguishing operations, beginning with discovery and continuing until a fire is completely extinguished.
Fire Swatter	Fire-suppression tool consisting of a flap of belting fabric fastened to a long handle used in direct attack for beating out flames along a fire edge.
Fire Weather	Weather conditions that influence fire ignition, behavior, and suppression.
Fire Weather Forecast	Weather prediction specially prepared for use in wildland fire control.
Firewhirl	Spinning vortex column of ascending hot air and gases rising from a fire and carrying smoke, debris, and flame aloft.
Firing Out	Act of lighting fire with a torch, fusee, etc., to accomplish burning out or backfiring. <i>Also see</i> Burning Out, Backfire, and Backfiring.
Flame Depth	Depth of the fire front; horizontal distance between leading and trailing edge of fire front.
Flame Height	Average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.
Flame Length	Distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.
Flammability	Fuel's susceptibility to ignition.
Flanking Attack	Attacking a fire by working along the flanks either simultaneously or successively from an anchor point.
Flanks of a Fire	Parts of a fire's perimeter that are roughly parallel to the main direction of spread.

Flare-Up	Any sudden acceleration in rate of spread or intensification of a fire. Unlike blowup, a flare-up is of relatively short duration and does not radically change existing control plans. <i>Also see</i> Blowup.
Flashy Fuels	Wildland fuels that are easily ignited and that burn rapidly when dry. Some examples are grass, leaves, pine needles, fern, tree moss, and some kinds of slash.
Floating Pump	Small, portable pump that floats on the water source.
Foam	Extinguishing agent formed by mixing a foam concentrate with water and aerating the solution for expansion. <i>Also see</i> Class A Foam.
Foehn Wind	Type of general wind that occurs when stable, high-pressure air is forced across and then down the lee slopes of a mountain range. The descending air is warmed and dried due to adiabatic compression; locally called by various names such as Santa Ana, Mono, Chinook, etc. Also called Gravity Wind.
Forestry Hose	Lightweight single-or double-jacket hose with lightweight (usually aluminum) couplings.
Frequency-Sharing Agreement	Written agreement between agencies that are licensed to use a communications frequency that allows the other agency to use the frequency under specified conditions.
Friendly Fire	Fully contained and controlled fire started for useful and nondestructive purposes.
Front	In meteorology, the boundary between two air masses of differing densities.
Frontal Winds	Winds generated by the movement of an air mass (front) across the earth's surface.
Fuel	Flammable and combustible substances available for a wildland fire to consume.
Fuel Break	Wide strip or block of land on which the native vegetation has been modified so that fires burning into them can be more readily extinguished. It may or may not have a fireline constructed in it prior to fire occurrence.
Fuel Characteristics	Factors that make up fuels such as compactness, loading, horizontal continuity, vertical arrangement, chemical content, size and shape, and moisture content.
Fuel Continuity	Degree or extent of continuous or uninterrupted distribution of fuel particles in a fuel bed, thus affecting a fire's ability to sustain combustion and spread. This applies to aerial fuels as well as surface fuels.
Fuel Loading	Amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.
Fuel Management	Manipulation of fuel prior to an incident to prevent the occurrence or slow the spread of wildland fire. Also called Vegetation Management or Weed Abatement.
Fuel Model	Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate-of-spread model have been specified.
Fuel Moisture	Quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212°F (100°C).
Fuel Volume	Quantity of fuel per unit area; usually expressed in tons per acre (tonnes per hectare).
Fusee	Colored flare designed as a railway warning device used to ignite backfires and other prescribed fires.
Gelling Agents	Superabsorbent liquid polymers capable of absorbing hundreds of times their own weight in water. These gels can be used as fire suppressants and fire retardants. Gels function by entrapping water in their structure rather than air, as is the case with fire fighting foams. Also called Durable Agents.
General Winds	Large-scale winds caused by high- and low-pressure systems but generally influenced and modified in the lower atmosphere by terrain.
Gradient Wind	Upper-level winds that flow around high- and low-pressure cells. Gradient winds flow clockwise around high-pressure cells and counterclockwise around low-pressure cells.
Gravity Wind	<i>See</i> Foehn Wind.
Green	Area of unburned fuels, not necessarily green in color, adjacent to but not involved in a wildland fire.

Greenbelt	Landscaped and perhaps irrigated fuel break that is regularly maintained; sometimes put to an additional use (for example, golf course, park, playground, pasture). Greenbelts may also be dedicated but unmaintained open space within or between developments.
Ground Fire	<i>See</i> Surface Fire.
Hand Crew	Individuals who have been organized and trained for operational assignments on an incident who primarily use hand tools to clear vegetation.
Handline	(1) Fireline constructed with hand tools. (2) Small hoseline (2 1/2 inch [65 mm] or less) that can be handled and maneuvered without mechanical assistance.
Hard Line	<i>See</i> Booster Line.
Head of a Fire	Most active part of a wildland fire; the forward-advancing part.
Heat Release Rate (HRR)	(1) Total amount of heat produced per unit mass of fuel consumed per unit time. (2) Amount of heat released to the atmosphere from the convective-lift fire phase of a fire per unit time.
Heat Transfer	Flow of heat from a hot substance to a cold substance. This flow may be accomplished by convection, conduction, or radiation.
Heavy Equipment	Ground vehicles such as bulldozers, tractors, and plows used in the suppression of wildland fires and their transport vehicles. Heavy equipment does not include fire apparatus.
Heavy Fuels	Massive natural cover fuels such as logs, snags, and large limbs. Heavy fuels are not easy to ignite; once ignited, they burn slowly and hot.
Heel	Rear portion of a wildland fire. Also called Rear.
Helibase	Main location on an incident for parking, fueling, maintaining, and loading helicopters.
Helispot	Temporary landing spot for helicopters.
Hose Lay	(1) Arrangement of connected lengths of fire hose and accessories on the ground at a wildland fire beginning at the first pumping unit and ending at the point of water delivery. (2) Connected lengths of hose from water source to pumping engine.
Hoseline Tee	Fitting that may be installed between lengths of hose to provide an independently controlled outlet for a branch line.
Hotshot Crew	Highly trained fire fighting crew used primarily in handline construction.
Hot Spot	Particularly active part of a wildland fire.
Hotspotting	Checking the spread of fire at points of more rapid spread or special threat only.
HRR	Abbreviation for Heat Release Rate.
IAP	Abbreviation for Incident Action Plan.
IC	Abbreviation for Incident Commander.
ICS	Abbreviation for Incident Command System.
Incident	Occurrence, either human-caused or natural phenomenon, that requires action by emergency services personnel to prevent or minimize loss of life or damage to property and/ or natural resources.
Incident Action Plan (IAP)	Contains objectives reflecting the overall incident strategy and specific tactical actions for the next operational period; may be oral or written. When written, the plan may have a number of forms as attachments.
Incident Base	Location at the incident where the primary logistics functions are coordinated and administered (formerly called “fire camp”). Incident name or other designator is added to the term “base.” The incident command post may be collocated with the base. There is only one base per incident.
Incident Commander (IC)	Person in charge of and responsible for the management of all incident operations.
Incident Command Post	Location at which the incident commander and command staff direct, order, and control resources at an incident; may be collocated with the incident base.
Incident Command System (ICS)	A standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

Incident Management System	System described in NFPA 1561, <i>Standard on Fire Department Incident Management System</i> , that defines the roles, responsibilities, and standard operating procedures used to manage emergency operations. Such systems may also be referred to as Incident Command Systems (ICS).
Indirect Attack	Controlling the fire by locating the control line along natural firebreaks some distance from the approaching fire and burning out the intervening fuels.
Infrared Radiation	Radiation with a wavelength outside the visible spectrum at the red end of the spectrum. Thermal radiation from free-burning fires is an example of infrared radiation.
Initial Action	<i>See</i> Initial Attack.
Initial Attack	Control efforts taken by the resources that are the first to arrive at an incident. Also called Initial Action.
Intensity	<i>See</i> Fireline Intensity.
Inversion	Increase of temperature with height in the atmosphere. Vertical motion in the atmosphere is inhibited allowing for smoke buildup. A “normal” atmosphere has temperature decreasing with height. <i>Also see</i> Atmospheric Stability.
Island	Unburned area within a fire perimeter.
Jackpot of Fuel	High concentrations of fuels.
Knock Down	To reduce the flame or heat on the more vigorously burning parts of a fire edge.
Ladder Fuels	Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and ensure the continuation of crowning.
Lapse Rate	Change of an atmospheric variable (temperature unless specified otherwise) with height.
Level-I Staging	A term describing temporary staging used when the exact location of a fire or the best access to it are not known. Responding units stop (stage) at the last intersection in their response route before the reported location of the fire and remain there until they receive instructions. Wildland firefighters should use standard ICS terminology—simply <i>staging</i> —when communicating with personnel from other agencies. <i>See also</i> <i>staging</i> .
Level-II Staging	A term describing location set up at an incident where resources can be placed while awaiting tactical assignments on a three-minute availability basis. Level-II staging is synonymous with the term <i>staging</i> in ICS. Wildland firefighters should use standard ICS terminology—simply <i>staging</i> —when communicating with personnel from other agencies. <i>See also</i> <i>staging</i> .
Life Safety	Refers to the joint consideration of the life and physical well-being of individuals, both civilians and firefighters.
Light Fuels	Fast-drying fuels, with a comparatively high surface-area-to-volume ratio, that are generally less than 1/4 inch (6.35 mm) in diameter and have a time lag of 1 hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.
Litter	Top layer of forest floor composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles; little altered in structure by decomposition.
Live Fuels	Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms rather than by external weather influences.
Local Winds	Winds that are generated over a comparatively small area by local terrain and weather. They differ from those that would be appropriate to the general pressure pattern or that possess some other peculiarity.
Lookout	(1) Person designated to detect and report fires from a vantage point. (2) Location from which fires can be detected and reported. (3) Fire crew member assigned to observe the fire and warn the crew when there is danger of becoming trapped.
Medium Fuels	Material available to burn in a geographic area that is in the midrange of size such as various brush species; generally excludes short grasses and large trees.
Mineral Soil	Soil containing little or no combustible material.

Mobile Attack	Suppressing fire along a fire edge by driving mobile apparatus along the perimeter and simultaneously applying fire streams to knock down the fire. Also called Pump and Roll.
Mobile Radio	Communications equipment mounted on vehicles and usually used from the cab and in some cases the pump panel. Not to be confused with handheld “portable” radios.
Moist Adiabatic Lapse Rate	Rate of decrease in temperature with increasing height of an air mass.
Mop-Up	Act of making a fire safe after it is controlled such as extinguishing or removing burning material along or near the control line, felling dead trees (snags), and trenching logs to prevent rolling.
Mutual Aid	Direct assistance from one fire agency to another during an emergency based upon a pre-arrangement between agencies involved and generally made upon the request of the receiving agency.
National Fire Danger Rating System (NFDRS)	Multiple index matrix designed to provide fire-control and land-management personnel with a systematic means of assessing various aspects of fire danger on a day-to-day basis.
National Incident Management System (NIMS)	A Federally mandated, standardized approach to incident management and response released by the Department of Homeland Security in 2004. NIMS incorporates the Incident Command System, common terminologies, and other elements of the older National Interagency Incident Management System (NIIMS), which it replaced.
National Wildfire Coordinating Group (NWCG)	Currently made up of the Department of Agriculture Forest Service (FS); four Department of the Interior agencies (Bureau of Land Management [BLM], National Park Service [NPS], Bureau of Indian Affairs [BIA], and the Fish and Wildlife Service [FWS]); the United States Fire Administration (USFA); and state forestry agencies through the National Association of State Foresters (NASF). The group’s purpose is to coordinate programs of the participating wildfire management agencies to avoid duplication and to provide a means of constructively working together. Thus it facilitates the coordination and effectiveness of wildland fire activities and provides a forum to discuss, recommend action, or resolve issues and problems of substantive nature. NWCG is the certifying body for all courses in the National Fire Curriculum.
Natural Barrier	Any area where lack of flammable material obstructs the spread of wildland fires.
NFDRS	Abbreviation for National Fire Danger Rating System.
NWCG	Abbreviation for National Wildfire Coordinating Group.
Offensive Strategy	Generally refers to direct attack on the fire perimeter by crews, engines, aircraft, or an aggressive indirect attack such as backfiring.
Operations Section	Section responsible for all tactical operations at the incident; includes branches, divisions and/or groups, task forces, strike teams, single resources, and staging areas.
Operations Section Chief	Person responsible to the incident commander for managing all tactical operations directly applicable to accomplishing the incident objectives.
Origin	<i>See</i> Point of Origin.
Overhaul	Searching for and extinguishing any hidden or remaining fire once the main body of fire has been extinguished.
Paracargo	Anything intentionally dropped or intended for dropping from any aircraft by parachute, other retarding devices, or free fall.
Parallel Attack	Constructing a fireline parallel to a wildland fire’s edge. After the line is constructed, the fuel inside the line is burned out.
Patrol	(1) To travel over a given route to prevent, detect, and suppress fires. (2) To go back and forth vigilantly over a length of control line during and/or after construction to prevent slopovers, suppress spot fires, and extinguish overlooked hot spots.
Penetrant	Water with added chemicals called “wetting agents” that increase water’s spreading and penetrating properties due to a reduction in surface tension. Also called Wet Water.
Perimeter	Entire outer edge or boundary of a fire.

Personal Protective Equipment (PPE)	Basic protective equipment for wildland fire suppression includes a helmet, protective footwear, gloves, flame-resistant clothing, and fire shelter as defined in NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting.
Pincer Attack	Direct attack around a fire in opposite directions by two or more attack units with the ultimate intent of pinching off (stopping) the head of the fire.
Point of Origin	Point of original ignition of a fire.
Portable Fire Pump	Small, gasoline-driven pump that can be carried to a water source by one or two firefighters or other conveyance over difficult terrain.
Positive-Displacement Pump	Gear pump or piston pump that moves a specified quantity of water through the pump chamber with each stroke or cycle; capable of pumping air and therefore is self-priming, but must have pressure relief provisions if plumbing or hoses have shutoff nozzles or valves.
PPE	Abbreviation for Personal Protective Equipment.
Preattack Planning	<i>See</i> Pre-Incident Planning.
Precipitation	Any or all forms of water particles, liquid or solid that fall from the atmosphere.
Preconnect	Hard suction hose or discharge hose carried connected to a pump, eliminating delay when hose and nozzles must be connected and attached at a fire.
Pre-Incident Planning	Act of preparing to handle an incident at a particular location or a particular type of incident before an incident occurs. Sometimes also referred to as Prefire Planning.
Prescribed Burning	Controlled application of fire to wildland fuels in either their natural or modified state under specified environmental conditions that allows the fire to be confined to a predetermined area and to produce the fire behavior and fire characteristics required to attain planned fire treatment and resource-management objectives. A written plan that describes specifically planned results and specific conditions as part of a vegetation-management program.
Presuppression	Activities in advance of fire occurrence to ensure effective suppression action.
Pretreat	Use of water, foam, or retardant along a control line or on anything in order to try to save it in advance of a fire; often used where ground cover or terrain is considered best for control action.
Priming Device (Primer)	Any device, usually a positive-displacement pump, used to exhaust the air from inside a centrifugal pump and the attached hard suction to create a partial vacuum within to allow atmospheric pressure to force water from a static source through the suction hose into the centrifugal pump.
Progressive Hose Lay	Laying hose from a fire pump to a fire's edge, extinguishing fire as far as the hose will reach, connecting another section, advancing while extinguishing fire as far as the hose will reach, connecting another section, etc. Used when mobile attack is not possible.
Progressive Line Construction	System of organizing workers to build a fireline in which they advance without changing relative positions in line.
Pump and Roll	<i>See</i> Mobile Attack.
Pyrolysis	Thermal or chemical decomposition of fuel because of heat; the preignition combustion phase of burning during which heat energy is absorbed by the fuel, which in turn gives off flammable tars, pitches, and gases.
Radiation	Transfer of heat through intervening space by infrared thermal waves.
Rappelling	Technique of landing firefighters from helicopters in hover, which involves sliding down ropes with the aid of descent-control devices.
Rate of Spread (ROS)	Relative activity of a fire in extending its horizontal dimensions. Expressed as rate of increase of the total perimeter of a fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually expressed in chains or acres (hectares) per hour for a specific period in the fire's history.
Rear	<i>See</i> Heel.
Reburn	Burning of an area that has been previously burned but that contains flammable fuel that ignites when burning conditions are more favorable; area that has reburned.

Reconnaissance	To examine an area to obtain information about current and probable fire behavior and other related fire-suppression information.
Rehabilitation	(1) Activities necessary to repair environmental damage or disturbance caused by wildland fire or the fire-suppression activity. (2) Allowing firefighters to rest, rehydrate, and recover during an incident.
Relative Humidity	Percentage of moisture in the air compared to the maximum amount of moisture that air will hold at that temperature.
Repeater	A fixed or mobile device that boosts the signal from a radio allowing for greater communication range.
Resource Tracking	A fireground management function in which each supervisor reports and documents resource status changes as they occur.
Resources	All personnel and major items of equipment that are available, or potentially available, for assignment to incidents.
Resources Unit	An Incident Command System function that maintains status of all incident resources. The resource unit works within the Planning Section of the Incident Command System.
Retardant	<i>See</i> Fire Retardant.
Retardant Drop	Fire retardant cascaded from an air tanker or helicopter.
ROS	Abbreviation for Rate of Spread.
Rotor Blast	Air turbulence occurring under and around the rotors of an operating helicopter. Also called Rotor Downwash from the main rotor.
Rotor Downwash	<i>See</i> Rotor Blast.
Running Fire	Behavior of a fire spreading rapidly with a well-defined head.
Saddle	Depression or pass in a ridgeline; low area on a ridgeline between two higher points.
Safe Refuge	<i>See</i> Safety Zone.
Safety Island	<i>See</i> Safety Zone.
Safety Officer	A member of the command staff responsible to the incident commander for monitoring and assessing hazardous and unsafe situations, and developing measures for assessing personnel safety.
Safety Zone	Recently burned area or one cleared of vegetation used for escape in the event a line is outflanked or a spot fire outside a control line renders the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand, allowing the fuels inside the control line to be consumed before going ahead. Sometimes called Safety Island or Safe Refuge.
Sandvik	A short-handled tool used for cutting brush and small saplings; also called a <i>Swedish brush axe</i> because of its replaceable blade made of Swedish steel.
Salvo Drop	Air tanker dropping its entire load of fire retardant at one time.
Scratch Line	Unfinished preliminary control line hastily established or constructed as an emergency measure to check the spread of fire.
Secondary Line	Any fireline that is constructed at a distance from the fire perimeter concurrently with or after a line has already been constructed on or near the perimeter of the fire; generally constructed as an insurance measure in case a fire escapes control by the primary line.
Set	(1) Individual incendiary fire. (2) Point or points of origin of an incendiary fire. (3) Material left to ignite an incendiary fire at a later time. (4) Individual lightning or railroad fires, especially when several are started within a short time. (5) Burning material at the points deliberately ignited for backfiring, slash burning, prescribed burning, and other purposes.
Shelter in Place	Remaining in a structure or vehicle when a fire moves through rather than attempting to use roads that may be blocked or untenable because of fire; opposite of evacuation.
Size-Up	Ongoing process of observation and evaluation of existing factors that are used to develop objectives, strategy, and tactics for fire suppression.
Slash	Debris left after logging, pruning, thinning, or brush cutting; includes logs, chunks, bark, branches, stumps, and broken understory trees or brush.

Sling Psychrometer	Meteorological instrument used to determine relative humidity.
Slope	Natural or artificial topographic incline; degree of deviation from horizontal.
Slope Winds	Small-scale convective winds that occur due to local heating and cooling of a natural incline of the ground.
Sloper	Fire edge that crosses a control line. Also called Breakover.
Slurry	Thick mixture formed when a fire-retardant chemical is mixed with water and a viscosity agent.
Smoke Jumper	Firefighter who travels to remote wildland fires and other emergencies by aircraft and parachutes to the scene.
Smoldering	Fire burning without flame and barely spreading.
Snag	Standing dead tree or part of a dead tree from which at least the leaves and smaller branches have fallen.
Span of Control	Maximum number of subordinates that can be effectively supervised; ranges from three to seven individuals or functions, with five generally established as optimum.
Split Drop	Two retardant drops made from one compartment at a time from an air tanker with a multicompartment tank.
Spot Fire	Fires starting outside the perimeter of a main fire typically caused by flying sparks or embers. <i>Also see Spotting.</i>
Spotting	Behavior of a fire producing sparks or embers that are carried by the wind to start new fires beyond the main fire. <i>Also see Spot Fire.</i>
Stable Atmosphere	Condition of the atmosphere in which the temperature decrease with increasing altitude is less than the dry adiabatic lapse rate. In this condition, the atmosphere tends to suppress large-scale vertical motion.
Staging	Process by which available resources are held in reserve at a location away from the incident while awaiting assignment.
Staging Area	Temporary incident location from which resources must be able to respond within three minutes of being assigned. Staging area managers report to the incident commander or operations section chief if established.
Static Water Supply	Supply of water at rest that does not provide a pressure head for fire suppression but may be employed as a suction source for fire pumps (for example, water in a reservoir, pond, or cistern).
Strategy	Overall objectives for an incident established by the incident commander.
Strike Team	Specified combinations of the same kind and type of resources with common communications and a leader. Strike teams are most often composed of either engines, hand crews, or bulldozers, but they may be composed of any resource of the same kind and type.
Structural Triage	Process of inspecting and classifying structures according to their <i>defensibility/indefensibility</i> based on their situation, their construction, and the immediately adjacent fuels.
Structure Protection Group/Sector	Individual responsible for supervising assigned strike teams, firefighters, or single resources in the defense of structures from wildland fire.
Subsurface Fire	Fire that consumes the organic material beneath the ground such as a peat fire or roots burning.
Subsurface Fuel	All combustible materials below the surface litter, such as tree or shrub roots, peat, and sawdust that normally support smoldering combustion without flame.
Suppressant	<i>See Fire Suppressant.</i>
Suppression	<i>See Fire Suppression.</i>
Surface Fire	Wildland fire that burns loose debris of the surface; includes dead branches, fallen leaves, needles, duff, stubble, grass, and low vegetation. Also called Ground Fire.
Surface Fuel	Fuel that contacts the surface of the ground; consists of duff, leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low-stature living plants. These are the materials normally scraped away to construct a fireline. Sometimes called Ground Fuel.
Sustained Attack	Continuing fire-suppression action until fire is under control.
Tactics	Deploying and directing resources on an incident to accomplish the objectives determined by the selected strategy.

Tandem	Two or more units of any kind working one in front of the other to accomplish a specific fire-suppression job. Term can be applied to combinations of hand crews, engines, bulldozers, or aircraft.
Target Hazard	Facilities in which there is a great potential likelihood of life or property loss.
Task Force	Any combination of single resources, within a reasonable span of control, assembled for a particular tactical need with common communications and a leader.
Ten-Codes	Numeric code words used in two-way voice radio communication for frequently used messages. There is no universal, official set of 10-codes, so the meanings of a particular 10-code can vary from one jurisdiction to another.
Thermal Belt	Elevation on a mountainous slope that typically experiences the least variation in diurnal temperatures and has the highest average temperatures and, thus, the lowest relative humidity. Its presence is most evident during clear weather with light wind.
Topography	Land surface configuration.
Torching	Vertical phenomenon in which a surface fire ignites the foliage of a tree or bush that becomes entirely involved in fire very quickly. A torching fire may or may not initiate a crown fire.
Tractor-Plow	Any tractor with a plow for exposing mineral soil.
Trail Drop	Dropping fire suppressant sequentially from tanks in aircraft so equipped; generally used in light fuels.
Trenching	Digging a trench across a slope to catch any burning material that could roll downhill and cross the control line.
Triage	<i>See</i> Structural Triage.
Turbulence	Irregular motion of the atmosphere usually produced when air flows over a comparatively uneven surface such as the surface of the earth; when two currents of air flow past or over each other in different directions or at different speeds.
Typical Tool Order	Order in which hand-crew members are assigned tools for varying types of wildland fuels. The types of tools necessary will be different for each fuel type.
Undercut Line	Fireline below a fire burning on a slope; should be trenched to catch rolling material. Also called Underslung Line.
Underslung Line	<i>See</i> Undercut Line.
Unfriendly Fire	Uncontained and uncontrolled fire of intentional or accidental origin that may cause injury or damage.
Unified Command	Unified team effort in the Incident Command System that allows all agencies with responsibility for the incident, either geographical or functional, to manage the incident by establishing a common set of incident objectives and strategies. This is accomplished without losing or abdicating authority, responsibility, or accountability. In unified command there is a single incident command post and a single operations chief at any given time.
Vegetation Management	<i>See</i> Fuel Management.
Venturi Principle	When a fluid is forced under pressure through a restricted orifice, there is a decrease in the pressure exerted against the sides of the constriction and a corresponding increase in the velocity of the fluid. This creates a slight vacuum into which any surrounding fluid will be drawn.
Virga	Precipitation that evaporates before reaching the ground.
Warm Front	Leading edge of a relatively warm air mass that moves in such a way that warm air displaces colder air. Winds associated with warm-frontal activity are usually light, and mixing is limited. The atmosphere is relatively stable when compared to cold-frontal activity.
Water Tender	Any ground vehicle capable of transporting large quantities of water; still called “tankers” in some regions.
Weed Abatement	<i>See</i> Fuel Management.
Wet Line	Line of water or water and chemical retardant sprayed along the ground that serves as a temporary fire-stop or containment line from which to ignite or stop a low-intensity fire.

Wetting Agent	Additive that reduces the surface tension of water (producing wet water), causing it to spread and penetrate more effectively, and that may produce foam through mechanical means. <i>Also see Penetrant.</i>
Wet Water	<i>See Penetrant.</i>
Whirlwind	Small rotating windstorm of limited extent containing sand or dust. Also called Dust Devil.
Wildland Fire	Unplanned and unwanted fire requiring suppression action; an uncontrolled fire, usually spreading through vegetative fuels. These fires can threaten structures or other improvements.
Wildland Firefighter I (NFPA)	Person, at the first level of progression, who has demonstrated the knowledge and skills necessary to function safely as a member of a wildland fire-suppression crew. The Wildland Firefighter I works under direct supervision.
Wildland Firefighter II (NFPA)	Person, at the second level of progression, who has demonstrated the skills and depth of knowledge necessary to function under general supervision. This person shall function safely and effectively as a member of a wildland fire-suppression crew of equally or less experienced firefighters to accomplish a series of tasks. The Wildland Firefighter II can be called upon to provide leadership and temporary supervision of a small crew. The Wildland Firefighter II maintains direct communications with a supervisor.
Wildland Fire Officer I (NFPA)	The person responsible for supervising and directing a single wildland fire suppression resource, such as a hand crew or an engine.
Wildland Fire Officer II (NFPA)	The person responsible for commanding and managing resources in the suppression of all aspects of an extended attack wildland fire or an initial attack exceeding the capability of the Wildland Fire Officer I.
Wildland/Urban Interface	Line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.
Wind	Horizontal movement of air relative to the surface of the earth.