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Chapter 22. Worksite Safety

Trail crews have one of the highest rates of injury among public employees and industrial laborers. Some of these injuries reflect the nature of the work - outdoors, rugged terrain, variable conditions, physically demanding, and working with tools that can inflict serious injury. Trail workers are frequently young and inexperienced, and enthusiastically tackle their work with great vigor and without considering the potential for injury to themselves and others. Volunteer crews can be unprepared for how physically demanding trail work can be, and are unfamiliar with basic hand tool use or how to work safely as a crew. Worksites may also be frequented by members of the public. However, by following some basic protocols, worksite and worker safety can be greatly improved.

22.1. Environmental Considerations

There are many potential hazards associated with working in an outdoor environment. Heat, cold, rain, wind, and extreme dryness can cause or contribute to illness and injury. A heavy rain can generate a flash flood; high winds can present a danger from falling trees or limbs; and thunderstorms can create lightning hazards. The crew must have a plan for safe evacuation or retreat until the hazard passes. (See Appendix P, *Emergency Response Plan*.)

Stinging and biting insects, poisonous or aggressive animals, and noxious plants are frequent sources of injury. Some injuries that are unreported at the time of incident have had life-altering and even deadly consequences. For example, a tick bite can cause Lyme's disease. These injuries are common among trail workers but are often not reported because they can seem relatively minor and routine. The following are some basic safety guidelines for dealing with potentially hazardous environmental conditions.

22.1.1. Wind

Windy conditions in a forested environment can be lethal. Falling trees or branches can cause serious harm to trail users and workers alike. Consider the following precautions if caught in a wind storm.

- No crew should enter a forested area during high winds and the crew leader should evacuate the crew if high winds develop.
- If caught in a forest during a wind storm, crew members should plan an escape route away from potential tree failures, and look up and listen for breaking trees and branches during wind gusts.
- The first storm of the winter may produce more windfall hazards under mild wind conditions due to the accumulation of dead material during the relatively calm summer and fall months.
- Gusting winds move in different directions and have a tendency to cause more windfall and breakage of treetops than steady wind.

- If working in one location for a long period of time, identify possibly hazardous limbs or trees and possible impact zones in the work area.
- If taking a break during windy conditions, continue to wear hard hats and stay aware of potential hazards.

22.1.2. Lightning

Lightning can be potentially hazardous to a trail crew, especially on high, open ground. Crew members should be aware of their surroundings and avoid high open areas if the conditions for lightning are present. If caught in a lightning storm, consider the following precautions.

- If caught on an open ridge, seek a mid-slope location so that projections such as trees or rocky outcrops are above you or protrude into the sky higher than you.
- If unable to evacuate from a ridge, quickly move below the top of the ridge and then off the ridge to low ground as soon as possible.
- In a dense forest, avoid groups of tall trees that can attract lightning. Instead, position yourself below a clump of short trees.
- If lightning strikes are close enough to produce a ground current, avoid positioning yourself in a gully, depression, overhang, or cave, and keep hands close to the body and off the ground.
- When lightning strikes are close, stop using hand-held tools and place them away from you.
- If unable to find a safe location when lightning strikes are close, the ideal position is crouched into a ball with only your feet touching the ground.
- Do not lie on the ground when lightning strikes are close. Have the least amount of contact with the ground as possible. If in a tent, do not lie down on the ground.

22.1.3. Rain

Working on trails while it is raining usually requires crew members to wear heavy, bulky, waterproof garments that restrict body movement and agility. Keep in mind that wearing rain gear may reduce visibility and impair hearing. If caught in a rainstorm, consider the following precautions.

- All crew members must ensure that they have properly fitting and functional rain gear when working in an area that may receive rain.
- Always be aware of slippery footing, especially when crossing wood or rocks. Use appropriate foot wear when working in the rain.
- Remember that when wet, tools are more difficult to control.
- Even though it may not be cold, crew leaders and members alike must be able to identify signs of hypothermia and its treatment. Most cases of hypothermia occur when the air temperature is 30 to 55 degrees Fahrenheit. Also, be aware that hypothermia can become a problem in windy conditions even when the temperature is warmer than 55 degrees Fahrenheit.
- Rain gear traps body heat and can cause workers to sweat more than normal. Monitor water intake and ensure that the crew stays hydrated.

22.1.4. Noxious Plants and Animals

Noxious plants and animals, such as poison oak, stinging nettle, and ticks, can exist in many work locations. It is important that all crew members are advised as to types of noxious plants and animals that may be encountered on a worksite and how to identify them. Infections caused by noxious plants and animals can be very uncomfortable and can result in lost work time or even hospitalization.

22.1.4.1. General Considerations

When working around noxious plants and animals, consider the following precautions.

- Crew leaders should be made aware of any crew members with special sensitivities or who have had previous adverse reactions to noxious plants and animals.
- Always protect exposed skin from contact with noxious plants by wearing gloves, a long-sleeve shirt with cuffs buttoned, long pants with cuffs closed around boots, and a face shield, if necessary.
- Avoid touching your face after handling noxious plants and animals and always be sure to wash skin after working around noxious plants. Skin should be washed within 30 minutes of exposure in cool or luke warm water with a mild detergent such as dishwashing soap to remove the oils associated with noxious plants.
- Check your body for ticks frequently when working in an area where they are known to occur. Crew members should also check each other for ticks, especially on the back and head.

22.1.4.2. Poison Oak

Poison oak (*Anacardiaceae rhus diversiloba*) produces urushiol, an oily substance that causes mild to severe skin irritation. The plant is native to California and frequently found in state park units. Poison oak causes the most common Workers Compensation injury in trail work and is especially prevalent in trail construction. People have different degrees of sensitivity to poison oak that can change from one year to the next. Just because a crew member has never had a reaction to poison oak does not mean they should be careless about contact with the plant or should not take the same precautions as everyone else. To minimize exposure, consider the following precautions when working in and around poison oak.

- Prevent skin irritation from poison oak by learning how to avoid contact with the plant. Crew members should be able to identify the plant by its leaves, stems, and roots. When cut, the stems and roots ooze a black, oily looking sap that contains urushiol equally potent as that in the leaves.
- Those with a known sensitivity to poison oak should avoid working in close contact with the plant. For example, do not run brush cutters through poison oak patches.

- Wear appropriate personal protective equipment (PPE) including gloves, disposable coveralls of impermeable fabric, and a helmet with face shield when operating a brush cutter.
- A barrier cream can be applied to exposed skin before starting work and re-applied every four hours, although you must wash the skin before reapplying. Reapplying cream without washing may spread any oil from poison oak that has been encountered, increasing the likelihood of a reaction.
- Use rakes and pitchforks to collect and carry cut brush to minimize contact.
- Give the crew members time to wash thoroughly with an appropriate cleanser immediately after working in an area of poison oak. If possible, also allow crew members to wash at periodic intervals during the day. Read and follow the instructions on the cleanser before use. Be aware that cleansers, such as Tecnu, specifically for minimizing the rash from poison oak are solvents (i.e., mineral spirits) that break down the oil and make it easier to be removed from the skin with water and detergent. If the cleanser is not removed, the urushiol, which was thinned and spread when using the cleanser, will affect a greater area of skin than originally affected by the initial contact with the plant. Even if a crew member is not sensitive to poison oak, maintaining good hygiene will prevent crew members from contaminating those that are more sensitive.
- Clothing can absorb the urushiol oil from the plant. Therefore, isolate contaminated clothing and gloves, and dispose of coveralls.
- Be aware of contaminating the inside of vehicles after working around poison oak. Disinfect vehicles periodically or after prolonged projects in poison oak to reduce the chance of contamination.
- All tools used around poison oak are likely contaminated and precautions should be followed in handling them, especially wire ropes and associated rigging pieces.
- Avoid burning poison oak because the smoke can cause severe respiratory as well as skin reactions.

22.2. Injury and Illness Prevention Plan

According to the California Occupational Safety and Health Act of 1973, every employer has a legal obligation to provide and maintain a safe and healthful workplace for employees. As of 1991, a written Injury and Illness Prevention Program (IIPP) with mandatory workplace protocols is required for all support facilities (e.g. workshops, warehouses, material storage yards, and fuel storage tanks) and trail projects. The following elements are typically required in an IIPP.

- Management commitment/assignment of responsibilities
- Safety communications system with employees
- System for ensuring employee compliance with safe work practices
- Scheduled inspections/evaluation system
- Accident investigation
- Procedures for correcting unsafe/ unhealthy conditions

- Safety and health training and instruction
- Recordkeeping and documentation

Trail projects must have a proactive program to identify, prevent, and respond to safety issues. Simply put, trail work is dangerous. The remote setting and difficulty of getting help to injured parties compound the danger. A manager must include safe working practices into every component of a trail program. Safe working practices should be so much a part of the culture of the program that employees do not have any other option but to work as safely as possible at all tasks. Review the basics, but keep safety meetings and discussions relevant to the realities the crew faces. Give the crew ownership of their safety but guide them to meet their obligations and hold the crew accountable for their actions and safety record. Remind them that injuries not only cause pain but also cost money. A sample IIPP can be found in Appendix Q, *Injury and Illness Prevention Plans*.

22.3. Task Hazard Analysis

Trail crews should be made familiar with the Task Hazard Analysis process. (See Appendix O, *Task Hazard Analysis*.) Agencies other than the Department, such as the U.S. Forest Service, refer to this as the Job Hazard Analysis. Although it is not the only means of addressing safety, this process lends itself well to trail work. A Task Hazard Analysis helps give the trail crew a clear vision of the project they are about to perform and requires the crew to participate in developing a plan to prevent injuries.

At the worksite before each trail project begins, the crew leader should walk the crew through the project to be sure they have a good understanding of why the project is being performed, the tasks required to perform the project, and the order in which those tasks will be performed. Upon completion of the project review, the crew leader facilitates the crew in the development of the Task Hazard Analysis and records the findings. Crew members identify all the tasks required to complete the project, the risks or hazards associated with those tasks, and the prevention methods they are going to implement to avoid or eliminate those hazards. Through this process, each member of the crew assumes responsibility for their own safety and that of others on the crew. A Task Hazard Analysis, with its references to real work situations and specific safety measures, gives the crew a plan to maintain safe working conditions. See Figure 22.1 for an example of a Task Hazard Analysis for cutting and stashing brush containing poison oak.

Sample Task Hazard Analysis: Cut and Stash Brush Containing Poison Oak

Steps to Accomplish	Sources of Injury	Preventive Measures
Cut and stash poison oak brush	Skin reaction to poison oak: primary exposure	Identify plant: including leaves, stems, roots, sap, seasonal variations.
		Identify especially susceptible employees; assign to tasks requiring minimal exposure.
		Personal Protective Equipment (PPE) to include: head protection (helmet, may include face shield if cutting with power tools), eye protection (in addition to face shield), impermeable clothing (Tyvek brand coveralls or rain gear), gloves (impermeable nitrile gloves may be worn inside leather gloves).
		Barrier creams (follow manufacturer's directions for application and duration of protection, re-apply as necessary).
		Collect and carry cut brush with rakes and pitchforks.
		Clean up regularly at recommended intervals not exceeding four hours. Use Tecnu brand or Zanfel brand skin cleansers, follow manufacturer's instructions precisely.
		Re-apply barriers after wash up. Swap out contaminated clothing when washing up.
	Skin reaction to poison oak: secondary exposure	Dust: tuck legs of impermeable coveralls into boots, maintain awareness of contaminated dust hazard.
		Clean tools as required; susceptible employees avoid using contaminated tools.
		Rigging, especially nylon slings, must be assumed to be contaminated.
		Poison oak tolerant employees must follow same hygiene practices as susceptible employees to prevent contamination of vehicles, etc.
		Boots and laces must be assumed to be contaminated; either clean or avoid contact.
	Systemic reaction to poison oak	Evaluate for possible sources of primary or secondary contamination, including vehicles, bedding, animals, tools, etc.
		Avoid smoke from fires that may contain poison oak.
		Consider re-assignment of personnel with history of systemic reaction to tasks with reduced exposure risk.

Figure 22.1 - Sample Task Hazard Analysis for Poison Oak

22.4. Accident and Emergency Reporting Procedures

Instruct employees to report all accidents and “close calls” to the crew leader. A “close call” is a situation or action that did not result in an injury but could have. Such reports are essential for monitoring where things go wrong, where additional training is needed, or where conditions make a project too dangerous to complete. If several crew members report slipping and falling on a muddy hillside, wait until conditions dry out before continuing with that phase of the project, or provide equipment such as caulked boots to enable the crew to maintain footing. Without reports, the crew leader and trail supervisor may be unaware of impending problems until something serious occurs. Once potential hazards are identified in a report, appropriate preventative measures can be developed and discussed with the trail crew at a project safety meeting.

22.4.1. Crew Injuries

All injuries, no matter how minor, must be reported to the crew leader immediately. Many agencies have a form and a process for reporting injuries. In the Department, minor injuries that don't result in lost time or the need for medical attention must be submitted on form DPR 761 "Report of Minor Injury," which is retained for two years from the date of the incident. Minor injuries include tick bites (if the crew member chooses not to seek medical attention), poison oak rashes (if not severe), blisters from tools or boots on feet or hands, and sunburns. Any accidents that result in the need for professional medical treatment must be reported on form SCIF 3067 "Employer's Report of Occupational Injury or Illness" within five days from the date of the incident unless the injury requires hospitalization of more than 24 hours. In that case, the trail supervisor must also notify the nearest Worker's Compensation office by telephone. Similarly, for any injury requiring medical treatment, the employee must complete form SCIF 3301 "Employee's Claim for Worker's Compensation Benefits."

22.4.2. Backcountry Emergencies

A backcountry injury is treated as an emergency if the injured person requires professional medical care. When an emergency occurs, the entire crew halts operations until the emergency is addressed. In case of an emergency, a well-drafted and accessible emergency response plan becomes vital. Elements of the emergency response plan should include procedures for emergency communications and emergency medical care (first aid or higher), and an evacuation plan. All backcountry projects must have a plan for dealing with injuries, so that the crew is prepared when one occurs and the injured person can receive treatment to prevent the injury from becoming more serious. When working in a backcountry trail crew, keep in mind the following precautions and procedures.

- Due to the remoteness and isolation, backcountry trail projects require more preparation and supervision than normal trail projects. A crew leader must be assigned to reside at a backcountry project 24 hours a day, seven days a week for the duration of the project. A radio signal capable of reaching an area repeater shall be set up at the spike camp. Individual crew members shall be

selected and trained to operate the radio and communicate with park staff. If coverage is available, a cell phone or satellite phone shall also be provided.

- A rotation system shall be developed to provide fresh batteries for communication equipment. Reserve batteries shall be available to ensure continuous communication at all times.
- A backcountry trail crew shall be provided with a portable, hand-held radio to be carried and used by the crew leader to communicate with the backcountry camp and the park.
- A backcountry trail crew shall be provided with a radio-equipped four wheel drive vehicle to be stationed as close to the backcountry camp as possible to provide back-up communication and ensure the expedient transport of an injured or ill crew member.
- Arrangements shall be made with park staff and other agencies as appropriate to monitor potential after-hours radio transmissions from the backcountry camp and ensure that emergencies are responded to as quickly as possible.
- If possible, have a person with Advanced First Aid, First Responder, or Emergency Medical Technician training assigned to the backcountry operation. There shall be a complete first aid/first responder kit available at camp and at the worksite. A litter and blanket shall also be assigned to the backcountry camp to transport injured crew members.

22.4.3. Backcountry Wild Fires

Crews in the backcountry often work the entire day with no outside communication. For this reason, it is important to notify the crew of any dangerous conditions that develop during the workday. A wildfire that starts off-site can entrap a crew working or living in a remote site. Crew members must evaluate the risk of fire based on the local fuel load, weather conditions, or type of work being performed. The trail crew must cease operations when trail work presents a significant risk of wildland fire. Guidelines for identifying hazardous conditions are issued and communicated by the relevant fire suppression authority (federal, state, or local) with jurisdiction over the project area. The trail supervisor should initiate contact with the relevant agency to ensure adequate communication.

A good practice is for the crew to use a satellite phone to check in each morning and evening with park headquarters to obtain fire or storm warning information. The satellite phone also allows park headquarters to leave messages that can be checked from the trail periodically throughout the day.

22.5. Visitor Safety

The top priority while performing trail work is to address visitor safety. Trail work must not endanger visitors. Whether or not an area is open to the public, assume that visitors will find their way to the worksite no matter how remote. Visitors may not have the awareness, experience, or training to deal with worksite hazards.

22.5.1. Trail Closed for Maintenance

If conditions on the trail prevent users from passing through the worksite safely, the trail should be closed to park visitors. These types of conditions include bridge failures or precipitous slopes along landslides. Obvious advantages occur when the crew has the opportunity to completely close a trail that needs work. However, within the Department, proper trail closure requires that several tasks be accomplished.

22.5.1.1. Notification to District Office

If it is determined by the trail supervisor that a trail is too hazardous for public entry and controlled public access is not feasible, inform the local park staff and notify the District Office that an official trail closure order is required. The trail supervisor then prepares a draft closure order for the superintendent's review and signature.

22.5.1.2. Public Notification

Every attempt should be made to provide users with advance notification of a closure. A public service announcement via radio and TV stations, newspapers, and park-generated publications is appropriate. Other government agencies, chambers of commerce, local neighborhoods, and user groups should also be contacted. A centrally located bulletin board can assist in providing trail users with up-to-date information on current trail conditions.

22.5.1.3. Signage and Monitoring

All entry points to a closed trail should be signed appropriately. The Department's standard metal signs may be adequate, but lighter weight Carsonite-type posts with decal strips or other temporary signage might be easier to install and remove. Consider including the estimated date for re-opening the trail and any alternative routes on the signage. Areas of extreme hazard should be signed and barricaded with caution tape, construction fence, or other physical barrier to keep visitors out. Promptly remove all the closure signs when the work is completed.

During trail closures, crew members should be posted to monitor the worksite; warn visitors of the hazards ahead; inform them to wait in a safe area until the hazard has passed; or communicate with the crew to cease hazardous operations until visitors are escorted through the worksite.

22.5.2. Trail Open During Maintenance

When the project presents a low safety risk to the public, it may be simpler to leave the trail open. This type of project should be scheduled during a period of low

visitation to minimize potential conflicts with visitors. When working on a low risk project, consider the following precautions and procedures.

22.5.2.1. Signage

Post a public notice of the construction activity at the same locations as would be done for a closure order. The notice should include the location and nature of the work, as well as trail conditions that may be encountered, such as muddy areas, extreme noise or dust, or heavy wheelbarrow traffic. At a minimum, a "Trail Work Ahead" sign is posted at the trailhead.

22.5.2.2. Work Habits

Crew members must constantly be alert to the development of hazardous conditions on the trail. Tools inadvertently left along the trail may create a hazard to trail users. Visitors entering the worksite must be announced to the crew members or escorted through the worksite. If visitors are allowed to proceed on their own, they must be advised of the appropriate safety precautions.

22.5.2.3. Equestrian Use

Equestrian use may require additional precautions for safe passage through a worksite. Crew members should turn off noisy equipment and avoid sudden movements as an equestrian passes through a worksite. The crew should stand on the downhill side of the trail, as visible to the horse as possible while it passes.

22.5.3. High Risk Situations

Some work, such as tree felling, wire rope rigging, or sand blasting, necessitate a high level of security, such as the placement of monitors at all approaches or temporary closure of the trail. Whether the trail is open or closed, high-risk areas must be flagged or barricaded to prevent users from accidentally entering the area. Of particular concern are bridges under construction. In the absence of a physical barricade, a user can walk onto a bridge that is not yet ready for use. In such situations, a barrier must be in place whenever the crew is not present.

Every project should be as safe as possible when the crew leaves, whether they are shutting down for the evening or going home for the weekend. Assume that visitors will come into contact with everything they can access and that any potential hazard left at or near the worksite represents a risk to unaware visitors. Potential hazards include railings or decking that are not yet nailed down and rocks or logs perched near the trail. If these items are not secured, they should be removed from the trail corridor until the crew returns. If a wire rope under tension crosses the trail, it should be released so it is lying on the ground and identified with flagging to make it more visible, or barricaded with caution tape.

22.5.4. User Compliance and Illegal Trail Use

Trail crews are not law enforcement. When encountering trail users that have ignored trail closure signs, they should politely inform the users of the hazards necessitating the closure and ask them to return back down the trail. If the users ignore the request and enter the closed area, the crew member should immediately notify the crew leader. The crew leader should halt all work activities until the users are out of the closed area. The crew leader should then immediately notify park law enforcement of the incident and provide a description of the users. More commonly, the crew encounters non-permitted user groups, such as cyclists or equestrians on hike-only trails. The crew should inform the user that the use is not permitted on the trail. If the crew has the knowledge, it can direct users to other areas where the use is permitted. The crew should not attempt to stop the user if they continue on the trail. The crew should get a good description of the individual and immediately inform law enforcement.

22.6. Crew Safety

Prior to undertaking a new project, ensure that the crew receives proper training on the safe use of basic tools.

22.6.1. Tool Safety

Crew leaders should thoroughly cover the safe use and handling of tools with the crew prior to starting work. Basic safety measures include the following.

22.6.1.1. Personal Protective Equipment

Personal Protective Equipment (PPE), such as hard hat, gloves, eye and hearing protection, and proper footwear, should be worn at all times, especially when using hand or power tools or when in close proximity to trail construction or maintenance activities.

22.6.1.2. Getting a Grip

Proper tool use begins with a good grip. Wet or muddy gloves may cause a worker to lose his or her grip on the tool, allowing it to slip and strike the worker or someone nearby.

22.6.1.3. Be Aware

Watch out for people nearby. When chopping or brushing, be aware of any people in the area including co-workers and trail users. Be aware of the combined length of arm and tool when maintaining a safe distance from co-workers. An unaware hiker may walk right into a crew member's backswing. If someone approaches the worksite, stop work, notify co-workers, and wait for the person to pass.

22.6.1.4. Maintaining Space

Make sure there is a wide, clear area in which to swing a tool. Watch out for hazards overhead or to the side or for anything that could interfere with the complete swing of a tool and cause it to fall or fly from the worker's hands. This spacing is often referred to as "maintaining your dime," a ten foot spacing between workers.

22.6.1.5. Maintaining Footing

Be alert for hazardous footing, such as loose rocks, branches, or other debris. Have a firm, balanced, and comfortable stance and clear any debris before starting work.

22.6.1.6. Tool Selection

Choose the right tool for the job. Don't waste energy trying to use the wrong tool for the job. Also, make sure the tool is sharp. A dull tool that bounces off what it was attempting to cut can be very dangerous. A sharp tool will cut faster and be less tiring to the worker. An axe or Pulaski used for chopping wood should be sharpened differently than one used for chopping roots. The shape and angle of the edge is critical to its cutting ability and its ability to retain its sharpness.

22.6.1.7. Tool Transport

Transport tools properly. Always carry tools by hand and down at the side of the body and keep the cutting edge of the tool facing downward toward the ground. This position allows the tool to be thrown away from the crew member in case he/she trips and/or falls. Use blade guards whenever possible. Never carry hand tools over the shoulder; a stumble or fall could be disastrous. For long distances, strap tools to a backpack for safe and easy handling.

22.6.2. Safety Harnesses

Personnel working near a steep drop-off, such as on a bare bridge stringer over a deep canyon, must wear a safety harness at all times. A harness should be maintained in good condition and be properly fitted to the person wearing it. The harness should be clipped from the designated anchor to an approved climbing rope with only as much slack as necessary to allow the worker the mobility required to perform the job. The other end of the climbing rope should be fixed to a secure anchor point or to a skyline not being used to hoist loads. Personnel wearing a safety harness should be trained to tie knots and use carabineers.

22.7. Chainsaw Safety

The most common and serious type of chainsaw injury involves being cut by the chain. A cut can be caused by unsafe operation of the saw, leading to a kickback. Careless movements or poor footing can cause cuts to the legs or feet. Improperly carrying or handling a saw, regardless of whether it's running, can also cause injury to the hands, face, or neck. Besides the potential to cut, a saw produces poisonous exhaust gas that can impair or injure the sawyer. A running or recently run saw has hot, exposed parts that can burn skin or ignite clothing. Saws also run on a mixture of fuel and oil, which can ignite and explode. Most chainsaw-related injuries can be avoided by the sawyer by using the proper safety equipment and features and following safe operating procedures.

22.7.1. Personal Protection Equipment

Anyone operating a chainsaw or working near a running saw should wear the following PPE.

22.7.1.1. Hard Hat

A hard hat will protect the sawyer's head from falling material and provide a degree of protection to the head and face in the event of a kickback. The suspension of the hat should be in good repair and fit the sawyer's head snugly. The helmet shell should be in good repair, free from breaks or cracks, and worn with the brim forward (over the eyes).

22.7.1.2. Chaps

Ballistic fabric leg coverings protect the front of the legs from cuts in the event of contact with the chain of the saw. Chaps should fit snugly to avoid catching in underbrush, but loose enough to allow free movement of the legs. Chaps should be in good repair, free of large cuts or loose strings. Leg straps should be kept buckled at all times.

22.7.1.3. Eye Protection

Securely-fitting, clear eye protection must be worn to protect the sawyer's eyes from smoke, dust, and flying wood chips. Wire mesh saw goggles offer good protection, unobstructed vision, and do not fog up with condensation. Goggles with lenses should be shatterproof, not excessively scratched, and keep fogging to a minimum. Prescription glasses with shatterproof or polycarbonate lenses are acceptable. Hard hats designed for use while operating a chainsaw that have a protective face shield that flips over the face is also acceptable.

22.7.1.4. Gloves

Heavy duty, well-fitting work gloves are vital to protect the sawyer's hands. Gloves are especially important when carrying or sharpening the saw or anytime the bare chain is handled. Gloves also provide a measure of protection from cumulative nerve damage by providing an additional cushion between the hands and the vibrations of the engine.

22.7.1.5. Hearing Protection

Protection sufficient to prevent auditory damage must be worn when excessive noise is expected on the worksite. Whether the protection is ear plugs or muffs, they must fit well and not interfere with the use of safety glasses or helmet.

22.7.1.6. Boots

Well-fitting boots suitable to the worksite must be worn to prevent slipping and falling or injury from dropped tools or materials. Boot tops should be high and snug to provide ankle support. Soles should provide traction adequate for the given environment. In most forested settings, caulks or caulked sandals provide the best footing. In extremely wet or muddy sites, heavy rubber boots may be used. Steel toes are optional on leather boots but highly recommended on rubber boots.

22.7.2. Standard Safety Features

The following safety features should be installed on a saw to help protect the sawyer. All safety features must be in place and functional or the saw should not be used.

22.7.2.1. Hand Guard

This device is attached to the front of the power head to keep the sawyer's left hand from contacting the chain if it slips off the front handlebar. It may be attached to a chain brake.

22.7.2.2. Chain Brake

When activated, this device stops the chain from turning. It usually works via a steel band that tightens around the clutch drum to stop the chain in a few thousandths of a second. It may be activated either through the centrifugal force of a kickback or by the sawyer's left hand striking the hand guard. Chain brakes should not be used to prevent the chain from turning while starting the saw or to hold a chain stopped on a saw with a defective clutch or idle adjustment.

22.7.2.3. Chain Stop

This small plastic or aluminum device is mounted on the bottom of the saw, forward of the clutch. It catches the chain and reduces the length of loose chain that may swing back toward the sawyer in the event that the chain breaks or is knocked loose from the bar.

22.7.2.4. Rear Chain Protection Plate

This plate extends out the right side from the bottom of the rear handle to the edge of the clutch cover. It primarily protects the sawyer's right hand in the same fashion as the chain stop.

22.7.3. Optional Safety Features

22.7.3.1. Reduced Radius Tip Bar

This saw bar tip has a radius that is narrower than the height of the rest of the bar, which reduces the likelihood of a kickback by reducing the size of the zone at the tip of the bar that causes most kickbacks. It may be of symmetrical or asymmetrical ("banana nose") design.

22.7.3.2. Low Profile Chain

This chain has cutter teeth of reduced height, which are less likely to catch on an obstruction as they pass around the top of the bar tip, and, thus, are less likely to cause a kickback. It is often incorporated with a guard link.

22.7.3.3. Guard Link Chain

This chain features a modified depth gauge (tie strap) that provides a smooth surface that protrudes higher than the top of the cutter tooth as the chain rounds the tip of the bar, reducing the chance of a kickback. Guard links reduce the chain's cutting ability and efficiency. It can be a hindrance to bore-cutting.

22.7.3.4. Kick Guard Nose Protector

This curved attachment can be fixed to the tip of the bar to protect the chain as it passes around the tip. It limits the size of the material that can be cut to less than full bar length, and, therefore, is of limited utility. However, it can be useful for cutting brush or small limbs.

22.7.4. Safe Operations

Never attempt to operate a power saw or brusher unless you have completed an approved training program. PPE and safety features are no substitute for training and experience when operating a chainsaw. All personnel should receive verbal and written instructions on safe operations, and should operate a saw in a variety of

situations under the guidance of a qualified sawyer before being authorized to use a saw independently.

To reduce the potential of fire when refueling gas powered equipment, allow the motor and muffler to cool before adding fuel. Store fuel at a designated location where containment measures have been taken and have spill protection materials available to reduce the risk of environmental contamination.

22.7.4.1. General Safety

When operating a chain saw, follow these procedures for safety.

- Always inspect a saw for proper assembly and functioning before use.
- Wear all appropriate PPE and ensure it is in good condition.
- Use safe handling practices at all times including when starting, carrying, or refueling.
- Carefully position hands, feet, and body while operating a saw.

22.7.4.2. Kickbacks

Kickbacks occur when the chain encounters something it cannot cut. If the tooth is traveling along the top half of the bar when it is caught, it forces the saw back in a straight line toward the sawyer. If the tooth is traveling around the upper half of the bar tip when it is caught, it throws the tip up and back toward the sawyer. In either case, the sawyer must be prepared for the kickback or suffer a possibly serious or fatal injury.

Most importantly in dealing with kickbacks is maintaining the proper stance and grip. A proper grip is with the left hand on the front handlebar with the thumb wrapped underneath and the left elbow locked straight. If the saw kicks back, the sawyer can maintain a grip on the saw and control the kickback. The head and body of the sawyer should be kept to the left of the saw bar, so if an uncontrolled kickback occurs, these vital areas won't be hit. In addition, before making any cut, determine how far the tip of the bar will reach into the tree and ensure that the tip will not contact any objects (e.g., knots or wedges) on the far side of the cut.

Under most circumstances, regardless of its position on the bar, a cutter tooth is most likely to cut the material it contacts. For this reason, keeping the engine running at a high RPM when cutting and keeping the teeth sharp are important to reducing the potential for a kickback.

22.8. Rigging and Manual Wire Rope Hoists

Rigging has a wide variety of applications in trail work, from removing large logs to constructing bridges. Manual wire rope hoists allow a trail crew to pack in enormous pulling capacity in a lightweight, compact, highly portable unit. A built-in “overload protection” device makes them very safe. There are a few simple points to bear in mind to keep a manual wire rope hoist functioning smoothly and safely.

22.8.1. Mainlines

Only the four-strand manual wire rope hoist mainlines are constructed to the tolerance needed for smooth operation. Be certain the wire rope is free of kinks, "birdcages," and frays. Keep it clean, or at least clean the wire rope before it passes into machine.

22.8.2. Handles

Use only the handles supplied by the manual wire rope hoist manufacturer. These handles are designed to lock onto the forward and reverse levers of the hoist. Metal pipe should not be used as a handle as it will not lock onto the levers and may damage the casing.

22.8.3. Clean and Lubricate

A manual wire rope hoist is full of small parts that must slide past each other for it to function. Even small quantities of dust, rust, or grit can impair function. Strive to keep the machine out of the dirt and mud as much as possible. Periodically dip the hoist into a cleaning solvent that will not damage nylon or rubber. Soak the hoist overnight, drain it in the upside down position, and allow it to dry. After drying, put the rope release lever in the open position and lubricate the hoist with SAE 90 to 120 weight motor oil. Grease or oil containing additives such as molybdenum disulphide or graphite should not be used as they will reduce the gripping efficiency of the jaws. It is impossible to over lubricate a manual wire rope hoist.

22.8.4. Shear Pins

Use only the overload shear pins supplied by the manufacturer for the hoist. Substituting with nails, drift pins, or drill bits can result in overloading the hoist's safe operating capacity.

22.8.5. Safe Working Loads

Before setting up a rigging operation, identify the safe working loads for all the components used in the system including the hoist, wire ropes, nylon straps, clevises, blocks, and wire rope grippers. The safe working load of any component used with the rigging system must not be exceeded by the force applied by the hoist

or any mechanical advantages used in the system. The failure point in any rigging system must always be the shear pins in the hoist.

22.8.5.1. Fly Zones

Wire ropes under tension sometimes move quickly. There are zones in any rigging operation in which it is unsafe to stand or work ("fly zones").

22.8.5.2. Straightening and Line Shock

Any time tension is applied to both ends of a load, as in a high lead with a brake system, the wire rope and the load will shift as tension is applied until they are extended in a perfectly straight line between the anchors. This shift can occur suddenly as the hoist applies more and more force to the load. If the wire rope is caught on an obstruction, such as a limb or root, it can suddenly release from that obstruction causing the wire rope to snap upward, sending a sudden shock to the system. This release can also cause the hoist to suddenly jump upward, possibly injuring the operator.

22.8.5.3. Rolling Load

Whenever a load is pulled across a hillside or down a hill, the possibility exists that the load may roll or slide down the hill suddenly. Such movement may even be the desired effect. When the load takes off downhill, it will take the wire rope with it. The wire rope will swing downhill with the load, possibly injuring anyone in its path until the load stops on its own, reaches the end of the wire rope, or the wire rope wraps around an obstruction. The hoist may also suddenly jump upward or sideways, possibly injuring the operator. Personnel operating the manual wire rope hoist must be aware of these hazards and be sure to stand in a safe area relative to the hoist and the wire rope.

22.8.5.4. Rigging Operation Under Tension

Whenever a rigging operation is under tension (force being applied to the load, lines, and points of attachment), there is a risk of failure within the system. To prevent injuries to workers, no one should be allowed to enter the area where any component of the system will travel in the event of a failure, including under overhead lines (wire ropes), under the load, or where a wire rope changes direction at a block and forms a "V" shape. If the block or anchor should fail, the wire rope and possibly the block will suddenly fly down into this V-shaped area. If someone needs to enter these areas while the system is under tension, slack the tension on the lines of the system before the worker enters the zone.

22.8.6. Tree Climbing

Tree climbing is a necessary part of setting a high lead or skyline. There are three basic ways to climb a tree.

22.8.6.1. Free Climbing

Free climbing is the least commonly used method because few trees that are appropriate for rigging have limbs close to the ground. Also, limbs can interfere with the rigging operation when the wire rope is tensioned or slacked. When free climbing, the "Three Point System" is used. The climber has a total of four "points" - two hands and two feet - that can be used to anchor oneself in a tree. The "Three Point System" of free climbing is to ensure that a minimum of three points (hands or feet) have a secure grip at all times.

22.8.6.2. Ladders

An ordinary extension or step ladder is not recommended for most tree work. Segmented tree climbing ladder systems that can be stacked to a variety of heights are useful for climbing trees up to about 4 feet in diameter. When used properly and set up by trained personnel using safety chains, pass ropes, and safety belts, this climbing system can be extremely quick and safe.

22.8.6.3. Spur Climbing

For large diameter (greater than 4 feet) trees with thick bark plates, specially trained personnel may use climbing spurs, belts, and pass ropes to climb a tree. This technique is very strenuous and can cause greater resource damage than ladder systems, but it requires less gear and, therefore, is more portable.