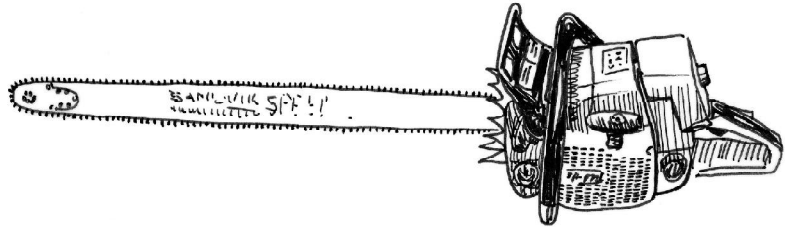


Wildland Fire Chain Saws

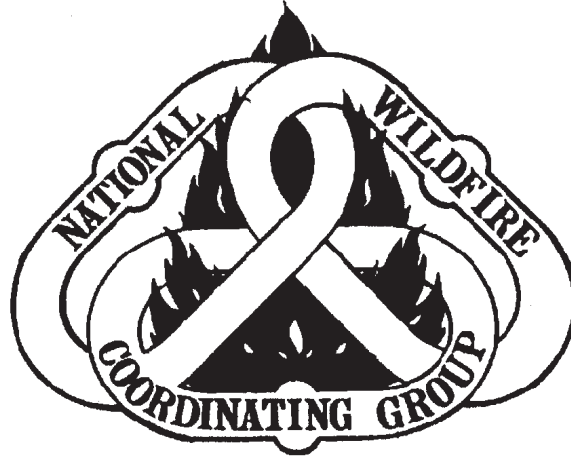
S-212



NFES 2000

Student Workbook

FEBRUARY, 2004



CERTIFICATION STATEMENT

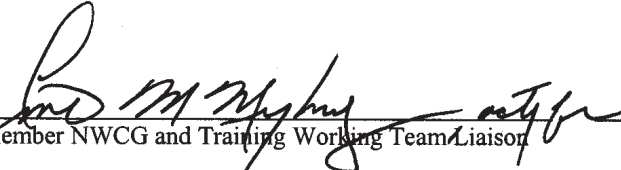
on behalf of the


NATIONAL WILDFIRE COORDINATING GROUP

The following training material attains the standards prescribed for courses developed under the interagency curriculum established and coordinated by the National Wildfire Coordinating Group. The instruction is certified for interagency use and is known as:

Wildland Fire Chain Saws, S-212
Certified at Level I

This product is part of an established NWCWG curriculum. It meets the COURSE DEVELOPMENT AND FORMAT STANDARDS – Sixth Edition, 2003 and has received a technical review and a professional edit.


Member NWCWG and Training Working Team Liaison


Chairperson, Training Working Team

Date February 18, 2004 Date 2/13/04

Description of the Performance Based System

The NWCG Wildland and Prescribed Fire Qualifications System is a “performance-based” qualifications system. In this system, the primary criterion for qualification is individual performance as observed by an evaluator using approved standards. This system differs from previous wildland fire qualifications systems which have been “training based.” Training based systems use the completion of training courses or a passing score on an examination as a primary criteria for qualification.

A performance-based system has two advantages over a training based system:

- Qualification is based upon real performance, as measured on the job, versus perceived performance, as measured by an examination or classroom activities.
- Personnel who have learned skills from sources outside wildland fire suppression, such as agency specific training programs or training and work in prescribed fire, structural fire, law enforcement, search and rescue, etc., may not be required to complete specific courses in order to qualify in a wildfire position.

1. The components of the wildland fire qualifications system are as follows:

- a. Position Task Books (PTB) contain all critical tasks which are required to perform the job. PTBs have been designed in a format which will allow documentation of a trainee’s ability to perform each task. Successful completion of all tasks required of the position, as determined by an evaluator, will be the basis for recommending certification.

IMPORTANT NOTE: Training requirements include completion of all required training courses prior to obtaining a PTB. Use of the suggested training courses or job aids is recommended to prepare the employee to perform in the position.

- b. Training courses and job aids provide the specific skills and knowledge required to perform tasks as prescribed in the PTB.
- c. Agency Certification is issued in the form of an incident qualification card certifying that the individual is qualified to perform in a specified position.

2. Responsibilities

The local office is responsible for selecting trainees, proper use of task books, and certification of trainees, see appendix A of the NWCG Wildland and Prescribed Fire Qualification System Guide, PMS 310-1, for further information.

**National Wildfire Coordinating Group
Training Working Team
Position on Course Presentation and Materials**

The suggested hours listed in the Field Manager's Course Guide are developed by Subject Matter Experts based on their estimation of the time required to present all material needed to adequately teach the unit and course objectives. The hours listed can vary slightly due to factors such as the addition of local materials. NWCG is aware that there have been courses presented in an abbreviated form, varying greatly from the suggested course hours. Instructors and students are cautioned that in order to be recognized as an NWCG certified course certain guidelines must be followed. These guidelines are:

- Lead instructors are encouraged to enhance course materials to reflect the conditions, resources and policies of the local unit and area as long as the objectives of the course and each unit are not compromised.
- Exercises can be modified to reflect local fuel types, resources and conditions where the student will be likely to fill incident assignments. The objectives and intent of the exercises must remain intact.
- Test questions may be added that reflect any local information that may have been added to the course. However, test questions in the certified course materials should not be deleted to ensure the accurate testing of course and unit objectives.
- Test grades, to determine successful completion of the course, shall be based only on the questions in the certified course materials.

If lead instructors feel that any course materials are inaccurate, that information should be submitted by e-mail to NWCG Fire Training at nwcg_standards@nifc.blm.gov. Materials submitted will be evaluated and, where and when appropriate, incorporated into the appropriate courses.

Wildland Fire Chain Saws

S-212

Student Workbook

FEBRUARY, 2004

NFES 2000

Sponsored for NWCG publication by the NWCG Training Working Team. The use of trade, firm or corporation names in this publication is for the information and convenience of the reader and does not constitute an endorsement by the National Wildfire Coordinating Group of any product or service to the exclusion of others that may be suitable.

Comments regarding the content of this publication should be directed to:
National Interagency Fire Center, National Fire Training Support Group, 3833 S. Development Ave., Boise, Idaho 83705. E-mail: nwgc_standards@nifc.blm.gov.

Additional copies of this publication may be ordered from National Interagency Fire Center, ATTN: Great Basin Cache Supply Office, 3833 South Development Avenue, Boise, Idaho 83705. Order NFES 1999.

PREFACE

Wildland Fire Chain Saws, S-212, provides introductory level training required for the use of chain saws in wildland fire management. This revision incorporates reference to requirements of the Occupational Safety and Health Administration (OSHA), that were lacking in previous versions. Coordination and assistance for this revision was provided by personnel from the following agencies:

USDA Forest Service
Winston Rall

USDI Bureau of Land Management
Nathan Gogna

USDI National Park Service
David Hamrick

USDI Bureau of Indian Affairs
Tony Deininger

National Interagency Fire Center, Fire Training Group
Brian Eldredge, Deana Parrish, Sue Hickman, Barbara A. Peterson,
Zoila ForrestDavis

Much of the core content of this course is directly adapted from the USFS Missoula Testing and Development Center's *Chain Saw and Crosscut Saw Training Course*. Without the hard work and dedication of those responsible for the creation of the MTDC course, this revision of the Wildland Fire Chain Saws would not have been as complete or technically accurate. The efforts of the following individuals are greatly appreciated: Chuck Whitlock, R. C. Carroll, Paul Chamberlin, David Michael, Winston Rall, Jerry Taylor-Wolf.

In addition to those listed above, input and review was provided by other federal, state and tribal agencies too numerous to list. Their generous insights and support are appreciated.

We extend a special thank you to Oregon Cutting Systems Group, Blount International Incorporated, for use of illustrations from the *Oregon Maintenance and Safety Manual*.

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Wildland Fire Chain Saws, S-212

Unit 0 - Introduction

OBJECTIVES: Through the course of this unit, the instructor will:

1. Introduce instructors and students.
2. Discuss administrative requirements of the course.
3. Introduce course objectives.
4. Review policy for chain saw operations.

I. INTRODUCTION

A. Welcome

B. Introduction of Instructors and Students

C. Course Administration

1. Breaks (coffee, tea, soda, candy/vending machines, drinking fountains, punctuality)
2. Smoking policy
3. Message location and available telephones
4. Restrooms
5. Other local information (restaurant locations, local map)
6. Transportation

II. ADMINISTRATIVE REQUIREMENTS

A. Course Objectives

Upon completion of the S-212 Wildland Fire Chain Saw course, the student will be able to:

- List, define and apply chain saw safety standards as required by OSHA and NWCG member agency manuals, handbooks and directives.
- Incorporate the approved use, maintenance and function of personal protective equipment (PPE) in wildland fire chain saw applications.

- Identify basic chain saw parts nomenclature, maintenance, tuning, troubleshooting, and safety features.
- Demonstrate field maintenance tasks required for chain saw operation.
- Demonstrate the tactical application of chain saws in brushing, limbing, bucking and falling for fireline construction and mop up operations.

B. Student Evaluation

The course has three methods of student evaluation:

- Subjective by the instructor based on participation
- Unit quizzes
- Field practicum (Exercise)

C. Performance-based Training System

This course prepares the student to be a trainee Faller A, performing low complexity project and fireline tasks under the supervision of a fully qualified evaluator.

The evaluator provides additional on the job training and mentoring to ensure the trainee's competence and preparation for the next higher skill level.

This course will provide the basic skills to safely use chain saws required by NWCG member agencies.

This wildland fire chain saw program was developed to provide new sawyers with a solid foundation for safe and efficient saw operation while limbing, brushing, bucking and felling for project work or fireline construction.

Student's final certification will be accomplished according to their employing agencies' standards.

Safety is the most critical objective of this course. Your safety, the safety of your coworkers, the safety of the public, and property protection should be a part of every plan and every action you take.

Careful study and practice of chain saw operations will improve your own abilities and help you identify your limitations to ensure safe saw operation.

III. CHAIN SAW PROGRAM

You must be aware of all government laws and agency standards that are required to be met before you operate a chain saw.

This course is designed to train beginning sawyers to perform project and wildland fire work safely and efficiently.

Wildland Fire Chain Saws, S-212

Unit 1 - Safety Requirements

OBJECTIVES: Upon completion of this unit, the student will be able to:

1. Describe the elements of a Job Hazard Analysis required for chain saw operations.
2. Define the Personal Protective Equipment required for chain saw operations.
3. Apply the safety components of the Situational Awareness-Individual Complexity Checklist.

I. JOB HAZARD ANALYSIS (JHA)

A JHA must be prepared (preferably with the assistance of the involved employees) before beginning any work project or activity. The JHA must:

- A. Identify the task or procedure to be accomplished. Such tasks could include limbing, bucking, or felling.
- B. Identify the hazards associated with the task or procedure. On wildfires we use the Incident Response Pocket Guide Risk Management Process to identify and mitigate hazards.

These hazards may include the following:

- 1. Physical hazards: Rocky terrain, slippery slopes, fire, power lines.
- 2. Biological hazards: Insect bites, hantavirus, snakes, blastomycosis, lyme disease.
- 3. Environmental hazards: Weather-related hazards such as hyperthermia, wind, lightning.
- 4. Chemical hazards: Hazardous materials such as fuel mix for chain saws, or bar oil.
- 5. Other hazards: Personal security issues, public traffic, hunting seasons, structures.

- C. Identify abatement actions that can eliminate or reduce hazards. Abatement actions include:
1. Engineering controls: The most desirable method of abatement (such as the chain brake built into the chain saw that reduces injury from saw kickback).
 2. Substitution: Such as switching to high flashpoint, nontoxic solvents.
 3. Administrative controls: Such as limiting exposure by reducing work schedules or establishing appropriate work practices and procedures.
 4. Personal protective equipment (PPE): The method that must always be used (such as using eye and hearing protection when working with chain saws).
- D. Identify first aid supplies and emergency evacuation procedures. In the event of an emergency evacuation, be prepared to provide the following information:
1. Nature of the accident or injury (avoid using the victim's name).
 2. Type of assistance needed (ground, air, or water evacuation).
 3. Location where the accident occurred, best access to the work site (road name or number).
 4. Radio frequencies, phone numbers.
 5. Contact person.
 6. Local hazards to ground vehicles or aviation.

7. Weather conditions (windspeed and direction, visibility, temperature).
8. Topography.
9. Number of individuals to be transported.
10. Estimated weight of individuals for air evacuation.

E. First Aid

The on-site first aid kit must have supplies that meet Occupational Safety and Health Administration (OSHA) specifications and requirements. A Type IV (ten person) first aid kit must be available as a minimum (General Services Administration national stock number NSN 6545-01-010-7754). A more complete kit that meets higher standards may be used.

In addition to the basic kit, additional trauma dressings, a survival (space) blanket and surgical gloves should be added.

F. Emergency Evacuation Plan

An emergency evacuation plan is essential for any field project, especially one involving chain saws.

All employees need to know:

1. Which frequencies and phone numbers to use and whom to contact in the event of an emergency.
2. The latitude and longitude and/or the legal location for an emergency medical helispot. The entire crew shall know where the helispot is located.

3. The emergency evacuation plan needs to be updated when the work location changes.
4. Ensure that vehicle egress is not blocked by activities, and that vehicles identified for evacuation are parked headed out.
5. The JHA and emergency evacuation plan shall be signed by employees, signifying that they:
 - have read and understood the contents
 - have received the required training
 - are qualified to perform the task or procedure
 - will comply with all safety procedures
6. Copies of the following must be kept on-site during the project:
 - JHA
 - the bloodborne-pathogen exposure control plan
 - the material safety data sheets for products used on the work project or activity
 - the emergency evacuation plan

The JHA can be reviewed and updated during tailgate safety brief/debrief sessions.

G. Personal Protective Equipment (PPE) Required for Chain Saw Operations

1. Items that must be included in the JHA:

- Approved hardhat (NFPA 1977-1998).
- ANSI approved eye protection.
- Appropriate gloves.
- Heavy-duty, cut-resistant or leather, waterproof or water-repellent, 8-inch-high laced boots with nonskid soles.
- Hearing protection (85 decibels and higher; chain saw produces 110-120 Db).
- Long-sleeved shirt.
- Pants, bloused (tied off at boot top).
- Chain saw chaps with a 2-inch boot overlap.
- Bar cover.
- Fire shelter (for fireline operations).

2. General requirements

- a. Select PPE based on hazards identified in the JHA.
 - PPE shall fit properly.
 - Defective, damaged, or unsanitary PPE shall not be used.
 - Supervisors shall ensure the adequacy of PPE as well as its proper maintenance and sanitation.
- b. Each employee shall be trained to wear the PPE required by the JHA. Training shall include:
 - The required PPE and when and how it should be worn.
 - Proper care, maintenance, useful life, limitations, and disposal of PPE.
- c. Employees need to demonstrate an understanding of their training in proper use of PPE.

Employees may be held accountable with personnel actions for accidents and injuries that result from failing to use, or misusing, required PPE.

3. Specific requirements

- a. Eye and face protection.
- b. Noise protection.

- c. Head protection: All wildland fire hardhats are designed to provide protection from impact and penetration hazards from falling objects.

Inspect helmet shells daily for signs of dents, cracks, penetration, or any other damage that might compromise protection.

Suspension systems, headbands, sweatbands, and any accessories should also be inspected daily.

- d. Hand protection: Gloves are often relied on to prevent cuts, abrasions, burns, and skin contact with chemicals.

- e. Foot protection: Footwear designed to prevent injury due to falling or rolling objects and objects piercing the soles.

Heavy-duty, cut-resistant or leather, waterproof or water-repellent, 8-inch-high laced boots with nonskid soles are required for chain saw use.

- f. Additional protection: Saw chaps, saw shoulder pads, or other PPE that provide cut resistance or puncture protection.

4. How chain saw chaps protect the user

When a chain saw strikes chain saw chaps, Kevlar™ fibers first resist the cut, then are pulled into the chain saw's drive sprocket, slowing and quickly stopping the chain (approximately five seconds or less). If the chap surface or pad is cut, it cuts the Kevlar™ fibers.

If another cut occurs it will only pull out the Kevlar™ strands that have been previously damaged, resulting in increased chance of injury. Chaps are only sewn along the edges to ensure the maximum amount of fabric will pull out to clog the chain and sprocket.

A back-coated nylon shell covers the Kevlar™ protective pad inside the chaps. The shell resists water, oil, and abrasions. The protective pad consists of five layers of Kevlar™. Kevlar™ is an aramid fiber similar to the Nomex™ material used in firefighter's clothing.

When chain saw chaps are exposed to temperatures higher than 500 degrees Fahrenheit, the nylon shell may melt, but the protective Kevlar™ pad will not burn.

Chain saw chaps need to be properly adjusted and worn snug to keep them positioned correctly on the legs. Proper fit and correct length (two inches past the boot top, or clear to the instep) maximize protection.

All chain saw operators and swampers shall wear chaps.

5. Chain saw chaps specifications
(MTDC-6170-4)

The Forest Service has provided cut-resistant protective chaps for chain saw users since 1965. Chain saw chaps have prevented thousands of serious injuries.

The Missoula Testing and Development Center (MTDC) monitors chain saw injuries. Because chain saws require right-hand operation, the majority of chain contact injuries occur on the left leg.

In 2000, the Forest Service chain saw chaps were redesigned. During tests, the new design provided protection to a chain speed of 3,200 fpm without a cut through.

The area of coverage was increased for the left side of the left leg by about 2½ inches, and for the left side of the right leg by about 1½ inches.

Only saw chaps provided by the General Services Administration meeting MTDC specifications 6170–4 are approved for federal agency purchase and use.

6. Inspection and replacement

Chain saw chaps need to be inspected and replaced when appropriate. Replace chain saw chaps when:

- a. The outer shell has numerous holes and cuts. Holes in the outer shell allow bar oil to be deposited on the protective pad. The oil acts as an adhesive, preventing fibers in the pad from moving freely, decreasing protection. Holes and cuts are indicators of near misses or improper use. Never allow a moving chain to touch the chaps.
- b. Wood chips and saw dust are evident in the bottom of the chaps.
- c. Repairs have stitched through the protective pad. Machine or hand stitching the protective pad prevents the fibers from moving freely, decreasing protection.

- d. Cleaning has been improper. Detergents with bleach additives decrease protection by compromising fiber integrity. **Do not bleach or machine wash or dry chain saw chaps.**
- e. High-pressure or machine washing has destroyed the protective pad.
- f. The chaps have a cut in the first layer of yellow Kevlar™ that is more than one inch long.

7. Caring for chain saw chaps

Treat your chain saw chaps as a **CRITICAL** piece of safety equipment. Keep them as clean as possible.

Appropriate and timely cleaning reduces the flammability of the chaps and keeps your clothing cleaner. **Do not use your chaps as a chain stop.**

8. Cleaning chain saw chaps

Hose and brush off chain saw chaps to remove dirt. **Do not** machine wash or machine dry chain saw chaps.

Use Citrosqueeze™, a commercially available citrus-based cleaning product, to clean chain saw chaps. Citrosqueeze™ has been tested and approved by Dupont for cleaning Nomex™ and Kevlar™. Citrosqueeze™ must be diluted before use.

- a. For light soiling, use a Citrosqueeze™ solution in a spray bottle, mixing 1 part Citrosqueeze™ concentrate to 10 parts water. Spray solution on the area to be cleaned and brush the solution into the chaps with a bristle brush. Wait one-half hour, thoroughly rinse the chaps with cold water, and allow them to air dry.

- b. For heavy petroleum contamination, soak chain saw chaps in Citrosqueeze™ solution for a minimum of four hours, overnight if possible. Brush the chaps with a bristle brush, rinse them thoroughly with cold water, and allow them to air dry.

Many pairs of chain saw chaps can be cleaned in a single soak tank. Use 10 to 15 gallons of solution in a soak tank.

A United States manufacturer for Citrosqueeze™ is:

Emco Industries
No. 118–2930 Norman Strasse Rd.
San Marcos, CA 92069
Phone: 888–727–3230

9. Repairs

Clean all chaps before repairing them. Repair cuts and holes in the outer shell as soon as possible to prevent the protective Kevlar™ pad from becoming contaminated with bar oil and petroleum products.

When repairing damage to the chaps' nylon shell, use a commercially available product called Seam Grip™. Seam Grip™ provides a flexible, waterproof, and abrasion-resistant patch that will prevent petroleum products from contaminating the protective Kevlar™ pad.

Remove chain saw chaps from service if they have a cut longer than one inch in the top layer of Kevlar™.

To repair holes and tears in the nylon shell:

- a. Cut a piece of notebook or printer paper that extends about two inches beyond the edge of the damage.
- b. Slip the paper inside the hole or tear so the paper lies on top of the protective Kevlar™ pad.
- c. Lay the chaps on a flat, level surface and press the nylon shell down onto the piece of paper.
- d. Squeeze Seam Grip™ onto the paper and onto the sides of the tear so that there is good coverage on all sides of the tear or hole.
- e. Allow the patch to dry for at least 12 hours before using the chaps. Seam Grip™ is available through outdoor retailers.

To locate retailers in your area, contact:

McNett Corp.
Box 996
Bellingham, WA 98227
Phone: 360-671-2227
Fax: 360-671-4521
Web site: <http://www.mcnett.com>

II. SITUATIONAL AWARENESS

The situational awareness checklist can be used for self-assessment during sawing operations. It can also be used for discussions, tailgate safety sessions, or one-on-one problem solving (performance or skill deficiency) in the field.

A. Checklist of Personal Safety Considerations and Attitude

- How *do* I feel about this sawing assignment?
- Am I exercising sound judgment and awareness?
- Is my attitude influencing me to go against my better judgment (gut feeling)?
- Is my mind on my work project or activity?
- Do I have self-confidence?
- Am I overconfident?
- Am I doing this against my will?
- Is peer pressure a factor?
- Am I professional enough to decline the assignment and ask for assistance?
- Do I have all of the required PPE and sawing equipment to do the job safely? Am I committed to using the PPE and equipment correctly?
- Am I complacent?

- Am I violating any safe operating procedures?
- Do I feel hurried or unusually stressed to get the tree on the ground or bucked?
- Have all options been considered and discussed with others?
- Am I in an unfamiliar environment and timber type?
- Do I watch out for my coworkers and the public?

B. Evaluating the Complexity of the Assignment

The individual sawyer must determine the complexity of the assignment.

Your evaluation of the complexity of the assignment must be based on your individual skill, knowledge, and your understanding of your personal capabilities and limitations. The final decision to cut any tree is left up to the individual sawyer. You have the responsibility to say *no* and walk away from any sawing situation that is beyond your capabilities.

If a thorough job of assessing the complexity of the individual situation has been completed, the decision to cut or not to cut will be determined by the GO-NO-GO process.

Straight forward – “I FEEL COMFORTABLE WITH THE SAWING SITUATION, I WILL CUT IT” or “I DON’T FEEL COMFORTABLE WITH THE SITUATION, I WILL WALK AWAY FROM IT.” **Do not base your decision on “I THINK I CAN DO IT.”**

1. Physical considerations:
 - General health
 - Physical conditioning
 - On medication or under the influence?
 - Fatigue (can affect good judgment)
 - Time of day
 - Work rest cycles (adequate rest)
 - Dehydration

2. Environmental considerations:
 - Light conditions
 - Rain
 - Fog
 - Snow
 - Smoke
 - Dust
 - Wind direction and speed
 - Insect damage
 - Heat
 - Cold
 - Forest density/tree spacing
 - Other factors that may affect your decision or the actual operation.

3. Escape routes/safe zones

When determining escape routes and safe zones:

- Walk out and thoroughly check the intended lay or bed of the tree. Look for dead treetops, snags and widow makers that may cause kickbacks or result in another tree or limb becoming a hazard.
- The escape route and alternates must be a predetermined path along which the cutter proceeds once the tree is committed to the fall or to the bucking cut.
- Safe zones should be no less than 20 feet from the stump.
- Stand behind another tree (sound and of sufficient size to give protection) watching for whiplash, broken tree parts, etc.
- When falling, escape routes and safe zones should be 45° to the sides and back from the direction of fall.
- Sawyers must select and prepare the work area, clear escape routes and alternates before starting the first cut.

4. Limbing

Examine the tree or log and immediate area for:

- Overhead and ground hazards
- Escape routes and safe zones
- Steepness of terrain (percent slope)

- Cutting area control
- Limbs under tension
- Spring poles
- Is the log suspended off the ground?
- Did the log move forward off the stump causing the limbs to flex back when cut?
- Did the tree twist or roll causing limbs on one side of the tree to flex up toward the sawyer when cut?
- Cut close to the bole
- Keep power head below shoulder height
- Use guide bar tip with caution to avoid kickback

5. Bucking

Examine the log and immediate area for:

- Percent of slope / incline
- Rolling
- Sliding
- Bind
- Tension

- Compression
- Rocks and foreign objects on or under log
- People and property in cutting zone or below
- Spring poles
- Fire
- Root wads
- Overhead hazards
- Rocks or other items the tree may dislodge
- Never buck a tree that is considered unusually dangerous
- Identify and avoid overhead hazards
- Is guide bar length adequate for the tree to be bucked apart completely?
- Can the log be bucked from two sides or the uphill side safely?
- Establish good footing, swamp out bucking areas and escape route
- Select bucking cut carefully
- Anticipate log's reaction when severed

6. Felling

Examine immediate work area for:

- People, roads and or vehicles
- Powerlines or fences
- Hang-ups
- Consider reaction of other trees
- Other trees that may have to be felled first
- Nearby hazards such as trees, rocks, brush, low hanging limbs
- Structures
- Openings to fall trees to
- Snags
- Fire weakened trees
- Widow makers

Examine surrounding terrain for:

- Steepness of ground
- Irregularities in the ground
- Draws and ridges
- Rocks
- Stumps
- Loose logs
- Ground debris that can “fly” back or kick up at the sawyer

Analyze the felling job by considering:

- Species; live or dead
- Diameter and height
- Soundness / defects
- Twin tops or school marm
- Widow makers and hang ups
- Heavy branches / weight distribution
- Burning top
- Spike top

- Splits and frost cracks
- Deformities such as mistletoe
- Damage by lightning or fire
- Heavy snow loading
- Bark soundness or slippage
- Direction of lean
- Degree of lean-slight or heavy
- Head lean or side lean
- Nesting and/ or feeding holes
- Rusty (*discolored*) knots
- Punky (*swollen & sunken*) knots
- Frozen wood
- Footing

Observe the base of the tree for:

- “thud” sounding
- Conks and mushrooms
- Rot and cankers
- Shelf fungi or “bracket”
- Wounds / scars
- Split trunk
- Insect activity
- Feeding holes
- Bark soundness
- Resin flow on bark
- Unstable root system / root protrusions

This order sets up the evaluation of hazards that would first set up a go/no go decision.

- If there are too many hazards surrounding the tree (no go), if not then (go).
- If the terrain doesn't allow for safe felling (no go), if not then (go).
- If there are too many hazards up in the tree or about the top of the tree (no go), if not then (go).
- If the stump or the base of the tree is in bad shape (no go), or in good shape then (go).

If the sawyer can't get past any surrounding hazards, then the tree should not be given any further evaluation. It is too hazardous to cut.

SITUATIONAL AWARENESS-INDIVIDUAL COMPLEXITY

THE COMPLEXITY OF THE ASSIGNMENT MUST BE DETERMINED BY THE INDIVIDUAL SAWYER.

This is based on his/her individual skill, knowledge and understanding of personal capabilities and limitations. The final decision to cut any tree is left up to the individual sawyer; therefore, giving her/him the choice to say "NO" and walk away from any sawing situation they have determined to be beyond their capabilities.

If a thorough job assessing the complexity of the individual situation has been completed, the decision to cut or not to cut will be determined by the GO-NO-GO process. Straight forward - "I FEEL COMFORTABLE WITH THE SAWING SITUATION, I WILL CUT IT" or "I DON'T FEEL COMFORTABLE WITH THE SITUATION, I WILL WALK AWAY FROM IT." **Do not base your decision on "I THINK I CAN DO IT."**

PERSONAL SAFETY CONSIDERATIONS AND ATTITUDE

- How do you feel about this sawing assignment?
- Are you exercising sound judgement and awareness?
- Is your attitude convincing you to go against your better judgement (gut feeling)?
- Is your mind on your work?
- Do you have self confidence?
- Are you over confident?
- Are you doing this against your will?
- Is peer pressure a factor?
- Are you professional enough to decline the assignment and ask for assistance?
- Do you have all the required PPE and sawing equipment to do the job?
- Are you complacent?

PHYSICAL CONSIDERATIONS

- General health
- Physical conditioning
- On medication or under the influence?
- Fatigue (can affect good judgment)
- Time of day
- Work rest cycles (adequate rest)

FELLING

Analyze the felling job by considering:

- Species; live or dead
- Size and length
- Soundness / defects
- Twin tops or school marm
- Widow makers and hang ups
- Heavy branches / weight distribution
- Burning top
- Spike top
- Splits and frost cracks
- Deformities such as mistletoe
- Damage by lightning or fire
- Heavy snow loading
- Bark soundness or slippage
- Direction of lean
- Degree of lean-slight or heavy
- Head lean or side lean
- Nesting and/ or feeding holes
- Rusty (*discolored*) knots
- Punky (*swollen & sunken*) knots
- Frozen wood
- Footing

FELLING (Continued)

Observe the Base of the Tree for:

- “Thud” sounding
- Conks & mushrooms
- Rot & cankers
- Shelf fungi or “bracket”
- Wounds / scars
- Split trunk
- Insect activity
- Feeding holes
- Bark soundness
- Resin flow on bark
- Unstable root system/ root protrusions

Examine surrounding terrain for:

- Steepness of ground
- Irregularities in the ground
- Draws and ridges
- Rocks
- Stumps
- Loose logs
- Ground debris that can “fly” back or kick up at the sawyer

Examine immediate work area for:

- People, roads and or vehicles
- Powerlines
- Driver trees
- Hang-ups
- Consider reaction of other trees
- Other trees that may have to felled first
- Nearby hazards such as trees, rocks, brush, low hanging limbs
- Structures
- Openings to fall trees to
- Snags
- Fire weakened trees
- Widow makers

ESCAPE ROUTES / SAFE ZONES

Walk out and thoroughly check the intended lay or bed of the tree. Look for dead treetops, snags and widow makers that may cause kickbacks or result in another tree or limb becoming a hazard. The escape route and alternates must be a predetermined path along which the cutter proceeds once the tree is committed to the fall or to the bucking cut. Safe zones should be no less than 20 feet from the stump, preferably stand behind another tree (sound and of sufficient size to give protection) watching for whiplash, broken tree parts etc. Escape routes and safe zones should be 90-135 degrees from the direction of fall. Sawyers must select and prepare the work area, clear escape routes and alternates before starting the first cut.

BUCKING

- Never buck a tree that is considered unusually dangerous
- Consider overhead hazards
- Is guide bar length adequate for the tree to be bucked
- Establish good footing, swamp out bucking areas and escape route
- Select bucking cut carefully
- Anticipate log's reaction when severed

Examine the Log and Immediate Area for:

- Percent of slope / incline
- Rolling
- Sliding
- Bind
- Tension
- Compression
- Rocks & foreign objects on log
- People and property in cutting zone
- Spring poles
- Fire
- Root wads
- Overhead hazards
- Rocks or other items the tree may dislodge

Wildland Fire Chain Saws, S-212

Unit 2 - Chain Saw Maintenance and Operation

- OBJECTIVES: Upon completion of this unit, the student will be able to:
1. Identify basic chain saw parts nomenclature, maintenance, tuning, trouble shooting and chain saw safety features.
 2. Demonstrate field maintenance tasks required for chain saw operation.
 3. Demonstrate chain saw starting and handling procedures.
 4. Demonstrate the use of tools that support field chain saw operations.

In this unit, students will learn the following field maintenance tasks for a chain saw:

- Removing the bar and the chain, inspecting them for damage and wear, and cleaning them.
- Removing and cleaning (or replacing) the air and fuel filter.
- Inspecting the power head for loose bolts and damage.
- Replacing the bar and the chain.
- Filing the chain.

ITEMS NEEDED FOR THIS UNIT:

TOOLS (NEEDED FOR EACH STUDENT GROUP):

- Chain saw
- Bar wrench (scrench)
- Torx or allen wrench (saw brand size specific)
- Files (round or flat) and hand file guide
- Bar cover
- Depth gauge
- Power head wrench
- Short section of chipper chain
- Short section of chisel chain
- Short section of semichisel chain
- Rags
- Axes (3 to 5 pounds)
- Wedges
- Approved safety container for fuel and oil

PPE (REQUIRED FOR SAWYERS AND SWAMPERS):

- Gloves (for instructor and students)
- Saw chaps (for field demonstration)
- Hearing protection (for field demonstration)
- Hardhat (for field demonstration)
- Eye protection (for field demonstration)

I. CHAIN SAW COMPONENTS

The bar and chain are the most important parts of your chain saw. A sharp chain produces shavings that fall to the ground away from the power head. A clean bar in good condition guides the chain through the cut, making a straight, true cut.

A dull chain produces sawdust that gets sucked into the air filter, cutting down the airflow to the power head and reducing power. A dull chain does not allow the saw to cut smoothly and puts unnecessary strain on the power head. The sawyer is forced to pressure into the cut, increasing the stress on the power head. An improperly maintained bar and chain will damage the power head.

As the sawyer works harder to make the saw cut, the sawyer may become fatigued, increasing the risk of accident or injury. A dull chain also increases the risk of kickback.

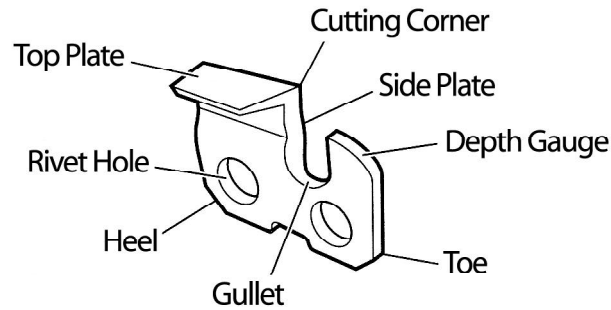
The primary purpose of this chain saw training course is to provide for the safety of all employees who operate chain saws. Selecting the proper chain is important to operate a chain saw safely.

A. Saw Chain Components

Saw chain—The most common types of saw chain cutters are chipper, chisel, and semichisel. Saw chain is made up of several parts that work together and must be properly maintained for maximum performance and safety.

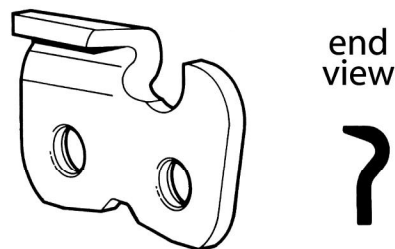
The cutter is the part of the saw chain that does the cutting. The saw chain has left- and right-hand cutters so that the saw chain will cut evenly through the wood.

The depth gauge (or raker) determines the depth of the cut. The cutting corner plate severs the cross grains. This is the hardest part of the work. The top-plate cutting edge chisels and removes the severed wood fibers, creating the kerf.



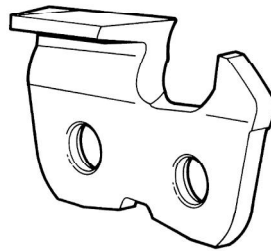
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1. The three most common types of saw chain cutters used are:
 - a. Chipper: The most versatile cutter type. Chipper chain is the easiest to file and will tolerate dirt and dust. Chipper chain cuts smoothly and is well suited for most wildland fire chain saw operations.



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- b. Chisel: The most aggressive cutter type. Chisel comes in both round and square ground types. The round ground chisel chain requires the proper size round file for proper sharpening.



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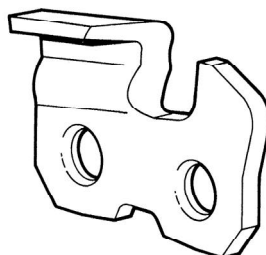


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It is designed to be used in production type felling for cutting clean wood. It is not recommended for brushing or limbing because of the potential for kickback.

This type of chain will dull rapidly in dirty cutting conditions like those that can be found in fireline conditions. The square ground chisel chain requires a double bevel, hexagon, or single bevel file to sharpen it.

- c. Semichisel: A less aggressive cutter type than a chisel cutter. A round file is used with a file guide when filing semichisel chain. The semichisel cutter is more tolerant of dirt and dust and stays sharp longer than the other cutters.



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view



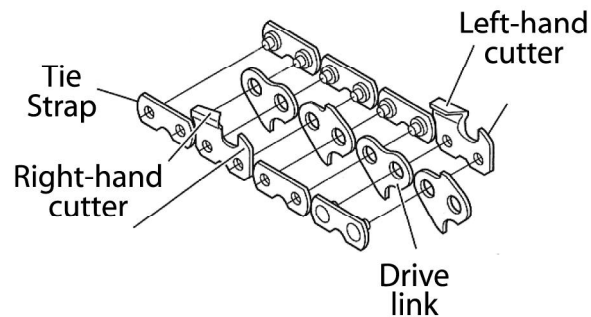
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Low-kickback chain is the most desirable chain for training inexperienced sawyers. The chain cuts smoothly and is ideal for cutting brush, small-diameter material, dimensional lumber, house logs, and other materials that aren't normally cut with chain saws.

Low kickback chain is available with chipper, chisel, and semichisel cutters. Less aggressive cutting angles and features added to the depth gauge and drive links provide lower kick-back response.

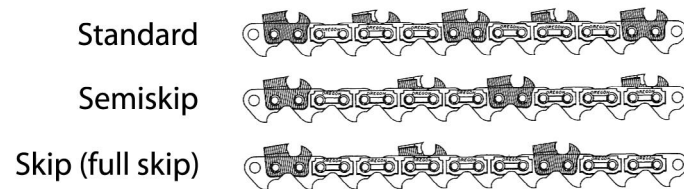
2. Other chain parts:

- a. Tie strap: Holds the parts of the saw chain together.



- b. Drive link: Fits in the bar groove so the bar can guide the chain, and into the chain sprocket so the power head can drive the chain around the bar. Draws oil from the bar groove to lubricate the bar and chain.

3. Cutter sequence:



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- a. **Standard (full-comp):** This chain has a cutter sequence of: left-hand cutter, tie strap, right-hand cutter, tie strap, left-hand cutter, tie strap, right-hand cutter, for the length of the chain. While this type of chain has low kickback, it is less aggressive and requires more time sharpening.
- b. **Semiskip (most common for wildfire use):** This chain has a cutter sequence of: left-hand cutter, two tie straps, right-hand cutter, one tie strap, left-hand cutter, two tie straps, right-hand cutter, one tie strap, left-hand cutter, for the length of the chain.
- c. **Skip or full skip:** This chain has a cutter sequence of left-hand cutter, two tie straps, right-hand cutter, two tie straps, for the length of the chain.

This aggressive chain removes dust and dirt from the cut well, but has higher kick-back.

When ordering replacement chain you must identify:

- Pitch - the measure between any two rivets divided by two (example, 3/8 found on bar tail).
- Gauge - the thickness of the drive link tang. May be marked on the side of the drive link.
- Number of drivers - 84 for a 24 inch bar (found on the bar tail).

It also helps to provide the make of saw and bar length. Most bars are marked with this information. Identify the type of cutter desired and whether it should be full comp or skip.

4. Types of guide bars

Guide bar: The guide bar supports and guides the saw chain. The most common types of bars are solid nose, sprocket nose, and bow bar.

- a. A solid nose bar is usually found on small saws. The bar is solid without a sprocket.
- b. A sprocket nose bar has a sprocket in the nose to reduce drag and help the chain move freely around the bar.

Bow bars are no longer approved for use by Stihl or Husquavarna chain saw owner's manuals. One of the primary reasons is that the bow bar changes the saw's center of gravity, preventing the chain brake from engaging properly during kick-back. Bow bars should be removed from service.

5. Parts of the chain saw

Bar studs—Hold the bar and chain sprocket cover in place.

Front and side chain tensioner—Moves the guide bar to maintain proper tension on the saw chain.

Chain sprocket—Is the toothed wheel that drives the saw chain.

Chain brake—Stops the saw chain if it is activated by the sawyer's hand or by inertia (during kickback).

Clutch—Couples the engine to the chain sprocket when the engine is accelerated above idle speed.

Chain catcher—Helps reduce the risk of the saw chain contacting the sawyer if the chain breaks or if the chain is thrown off the bar.

Starter Grip—A rubber or plastic handle attached to the starter pull rope.

Dogs (Bumper Spikes)—Hold the saw steady against wood.

Handlebar—Is used to hold the front of the saw.

Hand guard—Activates the chain brake and prevents contact with the chain if the sawyer's hand slips off the handlebar.

Gunning sights—Used to determine the planned direction of the tree's fall based on the undercut.

Rear handle—Used to hold the rear of the saw.

Throttle trigger—Controls the speed of the engine.

Oiler adjustment screw —Adjusts the amount of oil dispensed to the bar and chain.

Throttle interlock—Prevents the throttle from being activated unless it is depressed.

On/off switch—Turns the saw on and off.

Choke—Used for starting a cold saw.

Air filter cover—Holds the air filter in place and covers the carburetor.

Air filter—Prevents dirt, dust, and sawdust from entering the carburetor.

Fuel filter—Prevents dirt and other contaminants from entering the saw's carburetor.

Oil and fuel caps—Seal the oil and fuel tanks.

Muffler—Reduces exhaust noise.

Spark arrester—Prevents hot sparks from leaving the muffler.

Spark plug—Ignites fuel in the power head.

B. Carburetor Adjustments

Chain saws have a two-stage carburetor that provides fuel to the engine in any position in which a saw may be held. ALWAYS clean the air filter and recheck saw operation before making any carburetor adjustment.

The carburetor has three adjustments:

- Idle speed sets the speed at which the saw's engine will run by itself.
- Low-end speed controls the amount of fuel put in the carburetor when the throttle is not engaged.
- High-end speed controls the amount of fuel put into the carburetor when the throttle is engaged.

The high- and low-end adjustments should be made by a qualified saw mechanic. Improper adjustment can result in poor operation or severe damage to the chain saw.

The idle adjustment may need to be adjusted in the field. Before adjusting the idle, be sure that the air filter and fuel filter are clean and that you are using the right fuel mixture. Dirty filters or improper fuel mixtures affect the idle speed.

Newer saws designed to meet the U.S. Environmental Protection Agency (EPA) air quality standards may not have all three adjustments.

C. Mounts or Antivibration System

Buffers between the engine and the handles that reduce vibrations to the sawyer's hands.

II. MAINTENANCE

A. Guide Bar Maintenance

Most guide bar problems develop in the bar rails and are caused by:

- Incorrect chain tension
- Lack of lubrication
- Improper cutting techniques
- Normal wear

Look for several rail conditions when performing daily maintenance on your saw. These conditions can be corrected if they are caught early. If they are ignored, they will destroy the bar or lead to cutting problems.

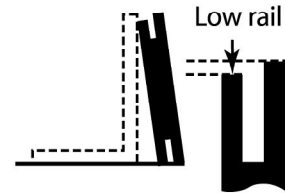
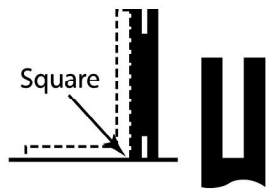
Poor rail conditions may prevent cutting straight or matching cuts on larger material. In addition, the chain may be thrown because the chain tension is harder to control.

- Rails are worn down and the groove becomes shallow. If the groove is too shallow and the tie straps do not touch the rails, replace the bar.
- The outside edges of the rails develop wire edges. Use a bar dressing or flat file to remove them.
- The rail is worn low on one side. This causes the chain to cut at an angle. The bar will have to be ground on a specialized bar grinder. You may need to take the bar to a dealer or to a trained saw mechanic if your unit doesn't have a specialized bar grinder.

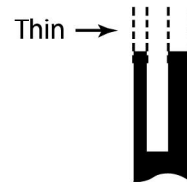
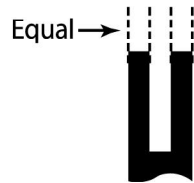
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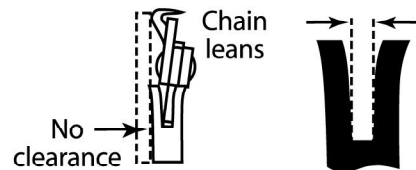
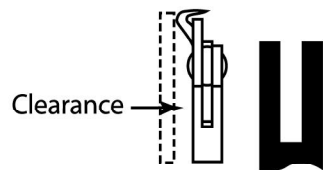
Square bar rails



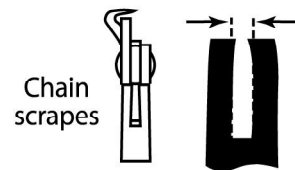
Rail thickness



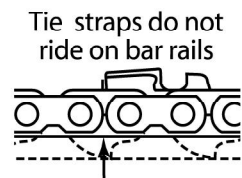
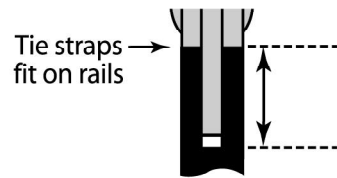
Groove splayed



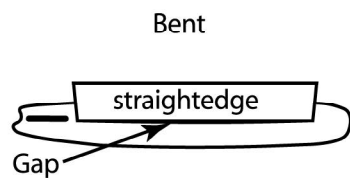
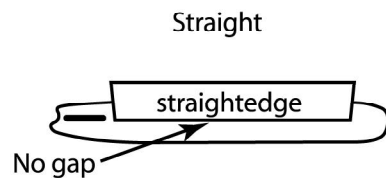
Groove pinched



Groove depth



Bent bar



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- The rails show blue discoloration along the bar or at the tip of the sprocket nose. This discoloration is caused by:
 - lack of lubrication
 - poor cutting methods that push the drive links to the side
 - a chain that is too tight
 - a dull or improperly filed chain

Blue spots are caused by excessive heat. The spots are soft and will wear rapidly; you will need to replace the bar.

- The bar shows excessive wear only behind the nose on solid nose bars or behind the sprocket on sprocket nose bars. This wear can be caused by heavy use near the nose of the bar (such as limbing) or by a chain that is too loose. You can reduce this wear by periodically turning the bar over. If wear becomes extensive, you may need to replace the bar.
- If the sprocket teeth on the bar are pointed, the tip should be replaced if possible. This condition causes chain wear on the drive link connection points.
- If the tip is not greased on a regular basis do not grease the tip. The bar and chain oil can provide lubrication to the bearings. If it is greased periodically the grease will aid in holding debris in the bearings shortening their service life. If the tip is being greased, the guide bar tip must be greased after every tank of gas.
- The bar is bent. This can be caused by improper cutting techniques, getting the saw pinched or bound in the cut, and improper transportation (such as carrying a saw loose in the bed of a pickup). Minor bends in bars can be straightened by a shop with the proper equipment.

There are hand held files designed to dress the rails of bars in the field that can be used, rather than taking them to a shop to be dressed. If the bar is in very bad condition, a specialized shop grinder may be necessary to reshape the bar rails.

The condition of the guide bar has as much to do with the performance of your chain saw as the condition of the chain. The bar and the chain work together. When both are in proper condition, the chain saw does the work. All you have to do is guide it.

B. Chain Tension

1. Remember three basic rules before tensioning a saw chain:

- Turn the saw off!
- Wear protective gloves.
- Wait until the bar and chain have cooled before adjusting the tension.

Heat causes the bar and chain to expand when the chain saw is being used. If the tension is set while the chain is hot, the chain will be too tight when it cools. Tension that is set too tightly can damage the bar and chain.

2. To adjust the chain tension on a solid nose bar:

- Disengage the chain brake.
- Loosen the bar nuts on the side of the saw.
- Pull the nose of the bar up and keep the nose up as you adjust the tension.

- Turn the guide bar's adjustment screw until the bottoms of the lowest tie straps and cutters just touch the bottom of the bar.
 - Still holding the nose up, tighten the rear bar nut, then the front bar nut.
 - Pull the chain by hand along the top of the bar several times from the engine to the tip. The chain should feel snug, but pull freely.
3. The tension must be tighter on a sprocket nose bar than on a solid nose bar. To adjust the tension on a sprocket nose bar:
- Disengage the chain brake.
 - Loosen bar nuts on the side of the saw.
 - Pull the nose of the bar up and keep the nose up as you adjust the tension.
 - Turn your saw's adjustment screw until the bottoms of the lowest tie straps and cutters solidly contact the bottom of the bar.
 - Still holding the nose up, tighten the rear bar nut, then the front bar nut.
 - Pull the chain by hand along the top of the bar several times from the engine to the tip. The chain should feel snug, but still pull freely. "Snap test" the chain tension by pulling down on the chain and letting it snap back into the bar groove, ensuring roughly 1/8 inch of free play.

C. Daily Saw Maintenance

As the chain goes around the bar, it wears the bar and the chain. Because the bar is made of softer metal, the bar wears more than the chain.

Generally, one rail will wear more than the other, causing the saw to cut at an angle if the bar and the chain are not properly maintained.

Chain saws have a chain oiler to provide lubrication to reduce friction between the bar and saw chain, minimizing wear and prolonging the life of the bar and chain. The oiler provides oil through a small hole in the bar that lines up with the oiler on the power head.

As oil is pumped through the oil hole, the chain carries it around the bar, lubricating the top, bottom, and roller tip. During operation, debris begins to build up in the chain groove. If the groove is not cleaned, oil cannot lubricate the entire bar, causing excessive wear and damage.

If the oiler is properly adjusted, a full tank of gas will run dry before the oil tank is empty. As a general rule, a tank of oil should last as long or longer than a tank of gas.

Clean and rotate the bar each time you file the chain or at least once a day. Be sure to wipe the bar clean after filing the chain because filings act as an abrasive, increasing the wear on the bar.

1. Remove the bar and chain for inspection and cleaning.
 - Check the bar for wear. Look for uneven rails, flared edges, cracks, and other damage that would require the bar to be repaired or serviced.
 - Clean the chain groove and oil holes. The proper method for cleaning the chain groove is to start at the tip with the bar tool and clean toward the base, moving debris away from the roller tip. Be sure that the oil holes are clean.
 - The sprocket nose (roller tip) should spin freely.

2. Remove and clean the air filter.
 - Never use compressed air to blow out the air filter. Using compressed air will drive contaminants into the filter and create holes in the filter material.
 - Manually close the choke to prevent debris from entering the carburetor.
 - Remove the air filter cover. Blow or shake off loose chips or particles surrounding the air filter.
 - Remove the filter from the carburetor. Take care not to damage the filter. Gently tap the filter against a hard surface. Don't rub or scrape it. Do not clean the filter with saw fuel. A damaged air filter can allow dust and debris into the engine, causing excessive wear and other problems.

- Follow the manufacturer's recommendations (found in the instruction manual) for cleaning the air filter and determining whether it needs to be replaced. If an air filter has a hole or any material is removed from the filtering agent, replace the filter immediately.
 - A soft paint or tooth brush can be used to brush off a filter. The best way to clean an air filter is with mild detergent and water and allow the filter to dry before using. A dirty or plugged air filter reduces engine power and performance and may cause other seemingly unrelated problems.
 - During wildfire operations, especially during mopup, you may need to clean the air filter more frequently to prevent performance problems or engine damage.
 - Never use a cleaning solvent or aerosol such as carburetor cleaner, engine starting fluid, etc., to clean an air filter as these products can damage an air filter.
3. Check the muffler and spark arrester.
- Replace the spark arrester screen if it has any holes.
4. Remove the spark plug.
- Check for fouling – the tip of the plug should be beige, not black.
 - The plug should be dry.
 - Check the plug weekly when the saw is in frequent use.

5. Inspect the power head for loose bolts and damage (black check).
 - Tighten the bolts or repair the power head if necessary.
 - Check the handlebars for loose bolts or cracks.
 - Check the dogs for loose or bent bolts.
 - Check the antivibration mounts. Look for cracks or damage in the engine mount system. Excessive movement of the engine or a loose feeling when the saw is held by the handles and shaken indicates that the mounts may be broken or that they need to be tightened.
6. Replace the bar and chain.
 - Rotate the bar so that it wears evenly.
 - Check for proper alignment of the bar with the bar studs, tension adjuster, and oiler.
 - Check the chain tension. The chain should be adjusted so that it doesn't hang from the bar but still turns freely.
 - Check the chain brake to ensure it's operating properly.
7. Inspect safety features of the chain saw.
 - Inspect the chain catch for looseness or damage and tighten or replace if necessary.
 - Inspect the chain brake and clean around the break area, removing any debris that may be built up around it.

- Inspect the throttle lock system to ensure it is functioning properly. If it is not, repair or replace it.
- Black Check (Stihl). By checking the condition and function of all black (gray for Husquavarna) fasteners, switches, and handles you have completed a full safety feature check.

D. Weekly Maintenance

- Check anti-vibration (shock absorption) systems for damage and wear.
- Check and lubricate clutch drum bearing.
- File off any burrs on side of guide bar.
- Clean spark plug and check gap.
- Check starter assembly and rewind spring for proper tension.
- Clean flywheel fins.
- Clean cooling fins on cylinder.
- Remove carbon buildup on muffler screen.
- Change screen when mesh openings exceed .025 inches (0.0635 cm).
- Clean carburetor body and under air filter cover.

E. Monthly Maintenance

- Check chain brake for wear.
- If tools and skill are available, check clutch center, clutch drum, and clutch springs for wear.
- Check fuel filter. Change if necessary.
- Flush inside of chain oil tank with straight gasoline.
- Flush inside of fuel tank with straight gasoline. Dispose of waste fuel correctly.
- Check all ignition and on/off switch cables and connections.

F. Storage

The chain saw must be protected against chemicals and moisture during storage.

1. Drain fuel from fuel tank. Run engine at idle speed until it stops. This will prevent gum and glue accumulating from fuel.
2. Turn fuel filler hole facing down, with fuel tank open, for five minutes. This will purge saw of fumes.
3. Remove spark plug and put a small amount of 2-cycle fogging oil in cylinder (read instructions on can). Turn engine over a couple times to distribute oil. Replace spark plug.
4. Remove saw chain and guide bar. Oil bar. Soak chain in oil and store in oil or oiled paper.
5. Cover chain saw and store in cool, dry place. If saw is stored for a long period, turn engine monthly to redistribute oil on cylinder walls.

G. Chain Maintenance

Chain maintenance is crucial to the performance of any chain saw. Before beginning any work assignment, follow four basic rules to maintain the saw chain for top performance and safe operation.

1. The chain must be correctly sharpened. When the chain is sharp, the chain does the work. When the chain is dull, you do the work, making you fatigued and increasing the wear on the bar, chain, and power head.
2. The depth gauges must be set correctly. The gauges' depths and shapes are critical to the saw's performance and your safety.
3. The chain must be correctly tensioned. More bar and chain problems are caused by incorrect chain tension than by any other single condition.
4. The chain must be well lubricated using only bar and chain oil. The bar, chain, and roller tip need a steady supply of oil. Otherwise, the bar and chain will be subject to excessive wear and damage.

Several conditions can increase the chain's potential for kickback, the risk of throwing or breaking the chain, or the risk of other hazards. Look for these conditions when inspecting your chain saw:

- Loose chain tension.
- Incorrect chain cutter angles (caused by improper filing).
- Dull chain.

- Alteration of chain features designed to reduce kickback.
- Incorrect depth gauge (raker) settings (generally too low).
- Improper shape of depth gauges after filing.
- Incorrectly installed chain parts.
- Loose rivets, or cracks and breaks in any chain part.

H. Chain Filing

This section focuses on chain filing with a round file and a clamp-on (handheld) file guide that clamps on the file, sometimes called a file holder. Using these files is the least complicated, least expensive, and most efficient way to file saw chain by hand in the field. Select a file that is the proper diameter for the saw chain, 7/32" is the most common size.

After the saw chain has been hand filed a few times, it should be ground on a chain grinder to restore angles that may have changed during hand filing and to grind all cutters to the same length.

Understanding how a cutter works will help you see why proper chain maintenance is so important.

The depth gauge rides on the wood and controls the depth at which the cutting corner bites into the wood.

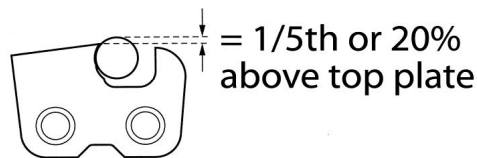
The cutting corner and side plate sever the cross grains.

The top-plate cutting angle (25-35°) pushes the cutter to the side creating the kerf. The chisel angle (directly under the top plate) chisels out the severed wood fibers, lifting them from the kerf.

Three angles must be maintained when filing or grinding a saw chain: top plate cutting angle; depth gauge setting; and side plate angle. A clamp-on file guide maintains these angles. The angles may vary for different types of saw chains.

1. Sharpening cutters with a round file

Be sure that the chain is tensioned properly. The file must be held at least one-fifth of the file's diameter above the cutter's top plate. The clamp-on file guide (or jig) positions the file correctly.



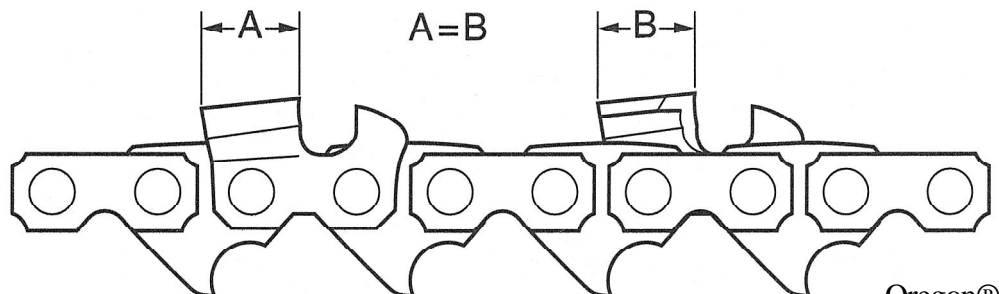
Oregon®

Maintain the correct top-plate angle (as marked on the file guide) by keeping the filing angle parallel with the chain.

It may be easiest to sharpen cutters on one side of the chain first, filing from the inside of each cutter to the outside. Turn the saw around and repeat the process for the remaining side.

If the chrome surface of the top or side plates has been damaged, file until the chip has been removed from the chrome surface.

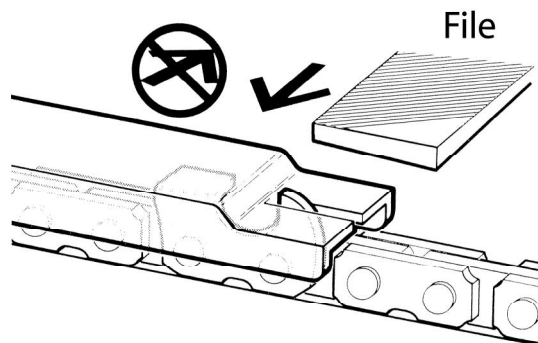
Try to keep the length of all cutters equal.



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2. How to set saw chain depth gauges

Use a depth gauge tool with the correct built-in setting for the chain. Place the tool on top of the chain so one depth gauge protrudes through the slot in the tool.



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If the chain depth gauge extends above the slot, use a flat file to file the depth gauge level with the top of the tool. Never file a depth gauge lower than the top of the tool.

Depth gauge filing is generally required after three cutter sharpenings. After lowering a depth gauge, round off its leading edge.

- Wear appropriate gloves for hand protection as described in your JHA.
- Make sure the chain is tensioned properly.
- Maintain the correct top-plate angle (as marked on the file guide) by keeping the filing angle parallel with your chain.
- File one side of the chain, then the other.
- Keep the length of all cutters equal.
- Set depth gauges with a depth-gauge tool.

III. SAW TRANSPORTATION

This section reviews three areas of saw handling: transporting the saw, starting the saw, and operating the saw.

A. Transporting Chain Saws

1. Transporting chain saws in a vehicle

- Keep the bar and chain covered with a chain guard.
- Properly secure the chain saw to prevent it from being damaged and to prevent fuel from spilling.
- Never transport a chain saw or fuel in a vehicle's passenger compartment.

2. Transporting chain saws by hand

- The muffler and power head can reach extremely high temperatures. Avoid these areas when carrying a saw that has been used recently.
- When carrying the saw for short distances, set the saw at idle speed and set the chain brake.
- When carrying the saw more than 50 feet (or in hazardous conditions such as on slippery surfaces or through heavy underbrush), the saw shall be turned off and carried in a way that prevents contact with the chain, muffler, and dogs.
- When carrying the saw on your shoulder, take extra care because of the sharpness of the chain and dogs. A long-sleeved shirt with collar turned up, gloves, and a shoulder pad must be worn. The bar, chain, and dogs shall be covered, preferably with a manufactured bar and chain cover.

3. Transporting chain saws and fuel by agency aircraft

USDA-FS and USDI have an exemption from Department of Transportation regulations that allows transportation of hazardous materials provided that the materials are transported in conformance with the agencies' handbook rules.

For aircraft transport in internal vented compartments, fuel containers must be marked as such, may not leak, must be tightly capped, and filled to allow vapor expansion.

Chain saws and fuel containers may be carried internally with fuel if:

- they are secured in an upright position that precludes spilling.
- the compartment is ventilated and does not contain an exposed battery.

Sigg™/MSR™ bottles must have an unvented cap in place, instead of a pouring spout.

If chain saws are to be transported in unventilated compartments, they must be purged. Fuel containers and fueled chain saws are not allowed in unventilated compartments.

Advise aviation personnel that you are transporting chain saws and/or fuel containers and obey their requirements.

4. Transporting chain saws by commercial aircraft

When mobilizing to an assignment by commercial passenger air, contact the carrier directly to determine whether they will accept a chain saw as baggage or not. If the carrier will accept a chain saw as baggage, it must be purged and completely clean of any petroleum products.

Plan for extra time at check-in for inspection of the chain saw, and be prepared to have it rejected for travel. Some cargo commercial carriers will accept chain saws for transport. Commercial carriers **will not** accept any used fuel or oil container for transport.

B. Chain Saw Operation

The methods to safely start and operate a saw vary with the make and model.

- Maintain a secure grip on the saw at all times.
- Always start the saw with the chain brake engaged.
- Start the saw on the ground or where it is firmly supported.
- Drop starting a chain saw is strictly forbidden.

1. Starting procedures

Take extra care when starting the chain saw. Because you won't have both hands on the saw, you will need to be more careful to maintain complete control. Remember that on/off switches may vary with different makes of saws.

- Ensure that appropriate PPE is available and is worn correctly.
- **Do not “drop start” a chain saw.** This is the most dangerous method of starting a saw because you have no control of the saw.
- **Always start the saw with its chain brake engaged.**
- Maintain a firm grip on the saw at all times.
- Start the saw on the ground or where it is firmly supported with the nose of the saw bar over a stump or log. To successfully start a cold saw:
 - Engage the choke.
 - Pull the starter cord until the saw “fires” or “turns over.”
 - If the saw continues to run, move the ignition switch to the Run position.

If the saw dies after briefly firing, move the switch to the Run position and pull the starter cord again until the engine starts. (Follow manufacturers' recommendations.)

2. Starting the chain saw

a. On the ground

- **Set the chain brake.**
- Place the saw on firm ground in an open area.
- Grip the front handlebar firmly with your less dominant (usually left) hand.
- Announce to bystanders that you are “STARTING UP.”
- Place the toe of your right foot into the rear handle and press down.
- Pull the starting rope with your dominant (usually right) hand until you feel resistance.
- Give a short, brisk pull. Avoid overly hard pulls on the starter rope which can lead to handle, rope or recoil spring damage.

Gradually return the starting rope to the housing.
DO NOT allow the starting rope to snap-back.

b. Starting between the legs

- **Engage the chain break.**
- Announce to bystanders that you are “STARTING UP.”
- Place left hand on front handle bar at the point where it bends around the starting coil side of the saw.

- Place the upper portion rear handle bar at the back of the right leg, tilting the saw to the right. Move the left leg over to firmly hold the saw against the right leg.
- Pull on the starting rope slowly pulling up until the starting mechanism engages. Then follow with a firm quick pull of the rope.
- Repeat until the saw starts, following manufacturers starting procedures.
- **Do not** allow the starting rope to snap back. Gradually return the starting rope to the housing.

C. Operational Safety

A full-wrap handlebar allows cutting from both sides of the tree using the bottom of the bar, the bar's most aggressive part. In some situations the ability to cut wood rapidly is critically important for safety.

Full-wrap handlebars are designed to be used by both the left and the right hand. The sawyer's thumb should always be wrapped completely around the handlebar, no matter how the saw is turned.

The thumb and fingers are essential for maintaining control of the chain saw, especially during a kickback. The grip on the chain saw should be firm, but not overly tight.

1. Handling

- Establish secure footing while operating a chain saw. Remove any ground debris that will not allow for stable footing.

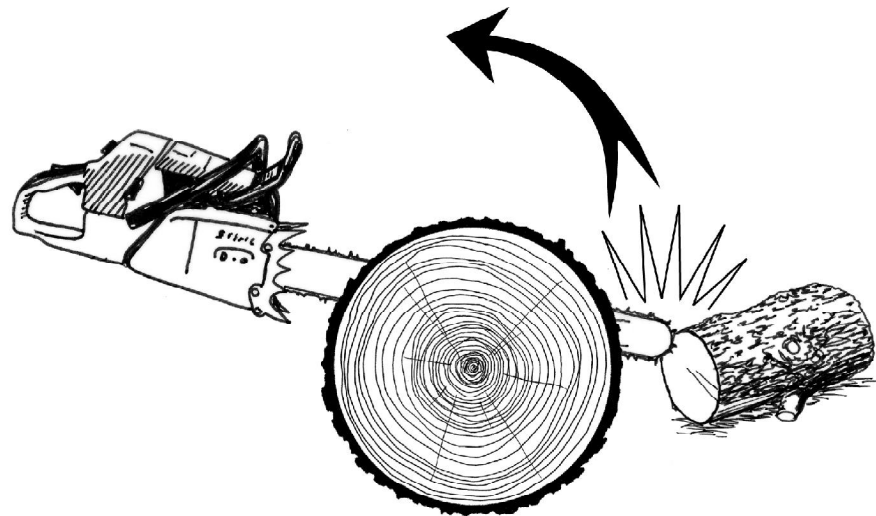
- Maintain a balanced stance with feet spread apart, knees bent, back straight, and a firm grip on the chain saw.
- When cutting with a chain saw do not overreach or lift or push with just your arms, use your legs, hips, and knees to turn.
- Never operate a chain saw with one hand. Because you do not have control of the saw, you increase the risk that you will be injured if the saw kicks back.
- Chain saws are engineered for right hand operation, and should be operated with the right hand controlling the throttle. Always grip the saw firmly with both hands, the left hand on the front handlebar and the right hand on the throttle and rear handle.
- Place your fingers tightly around the handle and the handlebar, keeping them between your thumb and forefinger.
- Never operate a chain saw with the throttle lock engaged. If you do, you cannot control the saw or the chain speed. The cold start throttle position used when the saw is cold automatically releases with trigger engagement.
- Maintain cutting area control. Make sure your immediate work area is clear of people and obstacles, such as rocks, stumps, holes, or roots that may cause you to stumble or fall.
- Make sure that the saw chain does not contact any materials such as rocks or wire. Such contact is a safety hazard and will dull the chain. The chain will require filing or it may be damaged in ways that filing cannot correct.

2. Reactive Forces

The laws of physics explain that for every action there is an equal and opposite reaction. These reactions happen very quickly during chain saw operation and can be dangerous.

- a. **Kickback** is the most powerful reactive force you will encounter while operating a chain saw.

Kickback can occur while felling, limbing, bucking, or brushing when the upper quadrant of the bar nose contacts a solid object or is pinched.



During kickback, the bar is forced up and back in an uncontrolled arc toward the sawyer.

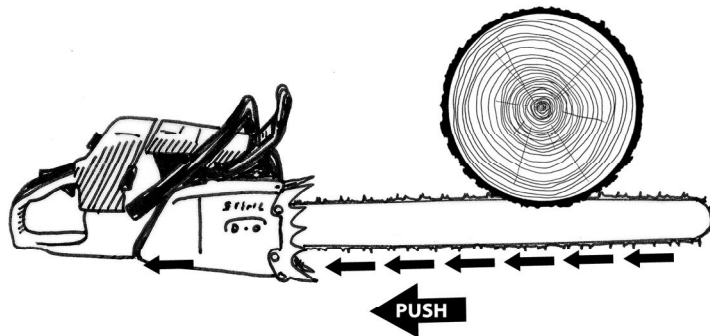
Many factors determine the severity of the kickback and the arc such as:

- chain speed
- angle of contact
- condition of the chain
- speed at which the bar contacts the object

Ways to avoid kickback:

- Hold the saw with both hands, securely gripping the handle and the handlebar between your thumb and forefinger.
- Be aware of the location of the bar nose at all times. Accidentally cutting with the top half of the guide bar tip is the most common mistake that causes kickbacks.
- Never let the bar nose contact another object.
- Never cut with the power head higher than your shoulder.
- Never overreach.
- Pull the saw smoothly out of the cuts. This technique will help to reduce kickbacks and fatigue.
- Cut one log at a time.
- Stand to the side of the kickback arc. Never rely on the chain brake to protect you from kickback injury.
- Use caution when entering the bar into a partially completed cut.
- Use a properly sharpened and tensioned chain at all times.
- Watch the kerf and the log for any movement that may pinch the chain.

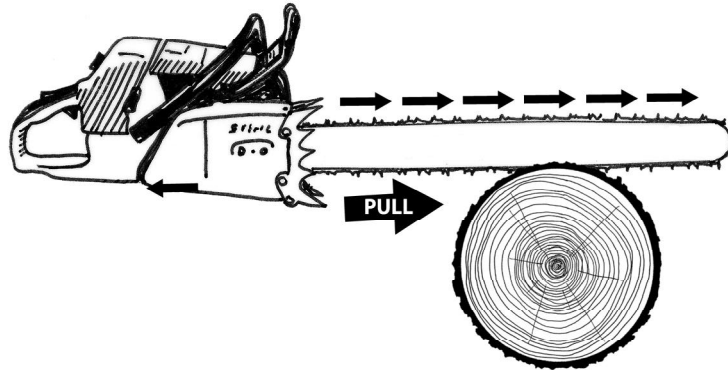
- Use a low kickback chain.
 - “Lock” the left elbow in situations where kickback is likely, such as limbing.
- b. **Pushback** occurs when the chain on the top of the bar is suddenly stopped by contacting another object or by being pinched. The chain drives the saw straight back toward the sawyer.



Ways to avoid pushback:

- Only cut with the top of the bar when necessary.
- Watch the kerf and the log for any movement that may pinch the top of the bar.
- Do not twist the bar when removing it from a boring cut or underbuck.

- c. **Pull-In** occurs when the chain on the bottom of the bar is caught or pinched, and suddenly stops. The chain pulls the saw forward.



Ways to avoid pull-in:

- Always start a cut with the chain moving at half or near full speed.
- Watch the cut and the log for any movement that may pinch the bar. Use wedges to keep the cut open.

IV. ADDITIONAL TOOLS

This section includes information about axes, wedges, approved safety containers for fuel and oil, peaveys, and cant hooks.

A. Axes

Axes are used to remove bark from trees and to drive wedges during felling and bucking. The axe handle should be smooth and free of cracks. The head should be securely attached to the handle. Axes used for driving wedges should have a straight handle.

Axes need to be heavy enough (3 to 5 pounds) to drive wedges into the trees being felled. The back of the axe should be smooth, have rounded edges, and be free of burrs to minimize damage to wedges. Pulaskis should never be used to drive wedges.

Always remove branches, underbrush, overhead obstructions, or debris that might interfere with limbing and chopping. Do not allow anyone to stand in the immediate area. Make sure workers know how far materials may fly. Protect all workers against flying chips and other chopping hazards by requiring them to wear the appropriate PPE.

Always position your body securely while working with a tool. Never chop crosshanded; always use a natural striking action. Be alert when working on hillsides or uneven ground.

If you cut a sapling that is held down by a fallen log, the sapling may spring back. Be alert for sudden breakage. If you do not have a need to cut something, leave it alone.

Never use chopping tools as wedges or mauls. Do not allow two persons to chop or drive wedges together on the same tree. When chopping limbs from a felled tree, stand on the opposite side of the log from the limb being chopped and swing toward the top of the tree or branch.

Do not allow the tool handle to drop below a plane that is parallel with the ground unless you are chopping on the side of a tree opposite your body.

If the cutting edge picks up a wood chip, stop. Remove the chip before continuing. To prevent blows from glancing, keep the striking angle of the tool head perpendicular to the tree trunk.

B. Wedges

Wedges are essential tools for safe felling and bucking. They provide a way to lift the tree, preventing the tree from sitting back when it is being felled.

A wedge must be inserted into the backcut as soon as possible. Wedges also reduce binds on the saw when bucking.

Select the correct wedge for the job. The proper type, size, and length of a wedge varies, depending on its use. The size of the tree being felled or the material being bucked determines the size of the wedge that will be needed.

If the wedge is too small, it may be ineffective. If the wedge is too long, it may not be able to do its job without being driven so far into the tree that it contacts the chain.

Always drive wedges by striking them squarely on the head. Only drive wedges with enough force to seat them firmly. Drive them carefully to prevent them from flying out of the cut.

Check wedges daily or before each job. Do not use cracked or flawed wedges. Wedges that are damaged need to be cleaned up before they are used again.

Recondition heads and the tapered ends when grinding wedges to the manufacturer's original shape and angle. Wear eye protection and a dust mask.

Repair any driving tool or remove it from service when its head begins to chip or mushroom.

Carry wedges in an appropriate belt pouch or other container, not in the pockets of clothing.

Most wedges are made out of plastic or soft metal, such as magnesium, and come in different sizes. Use plastic wedges in both felling and bucking operations to prevent damaging the saw chain if it contacts the wedges.

The two basic types of wedges used in sawing are single and double taper.

1. **Single-taper wedges** are simple inclined planes designed to provide lift during tree felling. As the wedge is driven into the back cut, the tree hinges on the holding wood, redistributing the tree's weight.

The sawyer must coordinate striking the wedge with the forward sway of the tree, allowing the wedge to be driven more easily and sending less of a shock wave up the tree.

Striking the wedge when the tree is in its backward sway sends a severe shock wave up the tree and can knock out dead branches or tops, endangering the sawyer. Sawyers should look up to avoid falling material after each blow to the wedge.

2. **Double-taper wedges** are designed to reduce bind. They taper equally from the centerline, forcing the wood to move equally in both directions. They perform best when used in bucking to prevent the kerf from closing and binding the guide bar.

C. Fuel and Oil Containers

1. The most commonly used fuel and oil container is the two-chambered (DOLMAR™ type) safety container. Transport the safety container with all lids fully sealed. Empty the container thoroughly before storage.

Even empty containers are dangerous. Large quantities of saw fuel need to be transported in an approved safety can.

- If a container is missing a lid or showing signs of a defect such as cracks, take it out of service immediately.
- All employees who handle, transport, or use flammable or combustible liquids shall receive hazard communication standards training and be familiar with material safety data sheets.
- Passengers shall not ride in the enclosed cargo portion of a vehicle hauling flammable or combustible liquids. If it is absolutely necessary to carry flammable or combustible liquids within a passenger vehicle, a minimum amount of such cargo shall be secured in a rack on the roof.
- Never transport fuel in the same cargo area with oxidizers, acids, or radio equipment because escaped vapors may combine and explode or electric currents may detonate vapors.
- Flammable or combustible liquids shall be carried in approved safety containers as defined by the National Fire Protection Association (NFPA 30). Such containers shall be clearly labeled to identify the contents.

2. Containers shall never be filled more than 90 percent with fuel. Fuel vapors need room to expand. There have been many cases of the aluminum Sigg™ and MSR™ type bottles splitting because they have been over filled.

Because the two-chambered (DOLMAR™ type) safety container is not equipped with a spring-loaded lid which relieves pressure build-up, it should be carefully vented when opened to avoid fuel splash.

3. Fuel mixing

Follow manufacturer's recommendations on the correct 2-cycle engine oil to gasoline mixture. It is important to only use oils formulated specifically for use in chain saw engines to avoid maintenance and wear problems.

- Remove any dirt and oil accumulation from the fuel container. Inspect the container for interior contamination and cracks. Rinse the container with straight gas if necessary and dispose of it properly.
- Always place the fuel container on a grounded surface at least 10 feet away from any ignition source.
- Add the correct amount of 2-cycle engine oil to the fuel container, then add the amount of gasoline required to obtain the proper fuel-oil ratio for the chain saw.
- Cap the fuel container and shake it to mix the oil and gasoline.
- It is easiest to mix large batches of fuel (five gallons or more) and then transfer the pre-mix to smaller containers for field use.

4. Fueling

A chain saw should be fueled only after the saw has cooled completely.

- Allow the saw to cool for at least five minutes before refueling.
- Fill the saw on bare ground or on some other noncombustible grounded surface.
- Immediately clean up spilled fuel.
- Refuel outdoors and at least 20 feet from any open flame or other sources of ignition.
- While the order used to refill the fuel and oil tanks isn't critical, it is important to make a habit of doing it the same way every time to avoid filling the tank with the wrong fluid. As a rule, fill the fuel tank first, then the oil tank. Do not over fill either tank.
- Hand tighten the fuel and oil caps, being careful not to cross thread them.
- Do not start the saw closer than 10 feet from the fueling area.

D. Peaveys and Cant Hooks

Although not generally found in fireline operations, peaveys or cant hooks are often needed for fire rehabilitation and project work.

Both the peavey and the cant hook use a curved metal hook on the end of a straight handle to roll or skid logs. A peavey has a sharp pointed spike at the lower end, while a cant hook has a blunt cap or lip.

Peaveys are handy for prying logs up onto blocks to keep the saw from pinching while bucking. The cant hook is used primarily to roll logs.

- Keep the handle free of splinters, splits, and cracks.
- Keep the point sharp.
- Keep your body balanced when pushing or pulling the pole.
- Grip the handle firmly. Do not overstress it.
- Place a guard on the point when the tool is not in use.

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Engine will not start	Switch off.	Turn switch to ON position.
	Fuel tank empty.	Fill tank with correct fuel mixture.
	Throttle not in starting position.	Engage throttle.
	Choke not engaged.	Pull choke on.
	Bad or stale fuel; water or fuel in gas; too much oil in mixture.	Empty tank and refill with correct fuel mixture.
	Over-choking.	Open throttle and reduce choke, pull starter several times until engine "pops."
	Flooded engine.	With switch and choke off, pull starter several times; remove spark plug, dry; crank engine several times with plug removed. Clean air filter.
	Spark plug fouled or incorrectly gapped.	Clean and regap or replace spark plug.
	Spark plug or ignition wires shorted.	Repair or replace wires.

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Engine will not start	Carburetor out of adjustment.	Readjust carburetor.
	Fuel filter clogged or frosted over.	Clean filter (temporary) and replace when possible.
	(In extreme temps) Fuel lines or carburetor icing.	Remove lines and clean. Add de-ice additive to fuel (follow manual recommendations).
	Faulty switch wires.	Repair or replace.
	Carburetor malfunctions (plugged jet, impulse hole, etc.).	Repair carburetor as needed.
Engine dies	Improper carburetor adjustments.	Readjust carburetor.

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Engine Dies	Water, ice or dirt in fuel.	Clean or replace fuel filter, drain tank.
	Fuel intake line kinked or partially plugged.	Clean or untwist line, replace, if necessary.
	Ignition wires short-circuiting or grounding.	Check all wire and connections and repair or replace.
	Seal(s) leak.	Replace seals.
	Cylinder gasket fails.	Replace gasket.
Engine will not accelerate	Low-speed mixture screw set too lean.	Adjust carburetor.
	Chain too tight.	Readjust chain tension.
	Carburetor defects or blockage.	Repair carburetor.
	Throttle linkage bent.	Straighten linkage.

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Chain continues moving with throttle released	Improper carburetor adjustment. Sprocket bearing worn out or dry.	Readjust carburetor.
	Broken or weak clutch springs.	Replace bearing.
		Replace springs.
Erratic idling with little or no response to carburetor adjustments	Loose carburetor.	Tighten carburetor.
	Fuel line stretched, damaged or loose.	Replace fuel line.
	Defective spacer.	Replace carburetor spacer.
	Split fuel pick-up line.	Replace line.
	Air leak due to worn or damaged main bearing seal or crankcase cover gasket.	Replace seals or gasket.
	Fuel line fitting loose.	Tighten fitting.
	Air leak due to carburetor gasket.	Replace gasket.
	Damaged crankcase O-ring.	Replace O-ring.
Cracked casting.	Replace casting.	

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Erratic idling with little or no response to carburetor adjustments	Wrong type of gas being used.	Drain tank and fill with correct fuel mixture.
Engine will not idle	Incorrect adjustment of idle fuel and/or speed screws.	Adjust screw(s).
	Idle discharge or air mixture ports clogged.	Clean ports.
	Fuel channel clogged.	Clean channel.
	Welch plug covering idle ports not sealing properly.	Replace plug.
	Throttle shutter misaligned.	Align shutter.
Engine runs rich	Main nozzle orifice not sealing.	Replace plug.

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Engine runs rich	Carburetor adjusted improperly.	Readjust carburetor.
Engine runs lean	Fuel tank vent or cap plugged.	Clean vent or cap.
	Leak in fuel line fittings between tank and carburetor.	Tighten or replace as necessary.
	Filter in carburetor or filter in fuel pick-up plugged.	Clean carburetor screen, clean or replace fuel pick-up filter.
	Fuel orifice plugged.	Clean orifice.
	Hole in fuel metering diaphragm or fuel pump diaphragm.	Replace diaphragm.
	Metering lever not set properly.	Adjust lever.
	Cracked crankcase.	Replace crankcase.
Loss of power	Dull chain.	Sharpen chain.
	Improper chain tension.	Adjust tension.
	Chain not oiling.	Clean and adjust oil port. Clean guide bar oil channel

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Loss of power	Clogged air filter.	Clean air filter.
	Dirty muffler and/or exhaust ports.	Clean muffler and/or exhaust ports.
	High speed mixture screw improperly set.	Adjust high speed mixture screw.
	Dirty carburetor.	Clean carburetor.
	Dirty fuel filter.	Clean filter.
	Oil breaking down.	Use proper oil.
	Oil tank check valve leaking into cylinder or crankcase.	Replace check valve.
Engine over-heats	Cylinder fins clogged.	Clean fins.
	Exhaust ports and/or muffler plugged.	Clean exhaust ports and/or muffler.
	High-speed adjustment too lean.	Adjust high-speed screw.
	No oil in gasoline.	Empty tank and refill with correct mixture.

TROUBLESHOOTING CHECKLIST

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
Engine over-heats	Oil breaking down.	Use proper oil.
Restart difficult when saw is hot	Fuel tank vent leaking.	Replace vent valve.
	Carburetor fuel inlet needle leaking.	Adjust inlet lever or replace inlet needle.
Heavy smoke, low power	Oil tank check valve leaking oil into cylinder or crankcase.	Replace check valve.
	Wrong fuel/oil mixture for saw.	Drain fuel and replace with correct mixture.

Wildland Fire Chain Saws, S-212

Unit 3 - Chain Saw Tasks and Techniques

OBJECTIVES: Upon completion of this lesson, the student will be able to:

1. Define the components required to complete a thorough hazard assessment for bucking, limbing, brushing, and falling operations.
2. Define types of binds and bucking methods.
3. Introduce the procedural approach to limbing, brushing and slashing, bucking, and felling.

I. LIMBING

The following safety precautions must be strictly adhered to when limbing; noncompliance could result in a serious injury or fatality.

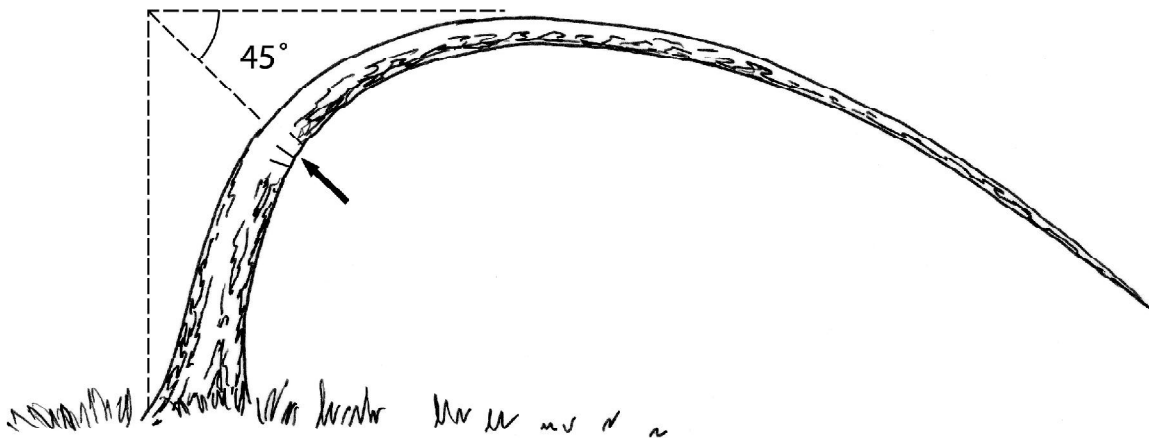
- A. Check for overhead and ground hazards before *any* limbing begins.
 - If a specific portion of the tree you are limbing has any overhead hazards, leave that portion of the tree unlimbed.
- B. Check for objects on the ground such as stumps, logs, and spring poles that may be hidden by the limbs of the felled tree.
 - If the tip of the bar inadvertently strikes an object, the saw may kick back.
- C. Maintain a firm grip on the saw with your thumb wrapped around the handlebar during all limbing activities, regardless of the direction in which the saw is turned.
 - Lock the left elbow and stand to the side of the kickback arc.
- D. Identify the direction the log may roll or move when the limbs are removed and avoid being in the path of the log.
 - Be sure you have firm footing as you are limbing.
 - Do not step forward until the limbing cut is complete.

- E. Identify the limbs which are supporting the tree's weight.
- Do not attempt to cut those limbs off in a manner that would allow the tree to roll or strike you.
 - Plan to remove these limbs last in an order that allows the tree to make a slow controlled fall to the ground.
 - Whenever given the opportunity to safely buck a portion of the tree off, do so to reduce the weight of the tree.
 - Always clear and plan an escape route.
- F. When limbing a log, right-handed sawyers should limb the right side out to the top before turning around and limbing the other side on their way back.
- Another option is to limb a tree out in sections. It is advisable to limb the far side of the log first, resting the saw's weight on the bole, keeping the bole between the bar and the sawyer as added protection.
 - Crossing over when limbing could result in injury.
 - Sawyers should select chain saw powerhead and bar length combinations based on their physical ability to manage the saw.
 - Bar length should be appropriate for the cutting task based on the size and type of material to be cut.
 - Bend at the knee and hips to maintain good body balance. Avoid bending at the waist to reduce back fatigue.

- G. Limbing kickbacks occur when the upper quadrant of the bar tip contacts an object and the chain is stopped.
- The rotating force of the chain is transferred to the saw body in a direction away from the cut.
 - Chance of injury depends on how well the sawyer maintains control of the chain saw, or if their body is positioned out of the kickback arc.
 - To reduce the chance of cutting the chaps or legs when limbing, only step forward when the chain has stopped moving, or when the guide bar is on the opposite side of the stem or log.
 - Over-reaching is generally at fault for limbing kickbacks. The shorter the bar the more severe the kickback. Modern saws are equipped with an inertial brake that automatically engages the chain brake before the hand guard reaches the hand.
 - The chain is more likely to be thrown when you are working with small material. Check the chain tension often. Sawing close to the ground increases the chances of kickback and damage to the chain. Watch out for rocks and other debris.

- H. Spring poles are limbs or small trees that are bent over and are under extreme tension.

Spring poles are encountered frequently when limbing. They can cause serious injury. If spring poles are not cut properly, they can spring back and strike the sawyer or throw the chain saw back into the sawyer.



Sawyers must recognize spring poles and use the proper technique when cutting them. One of two methods may be used:

1. Stand back at a safe distance. Make a series of shallow cuts less than one half of the spring pole's diameter in the compression side and roughly $\frac{1}{2}$ " apart. As soon as movement or pinch is detected, remove the saw and begin the next cut. Four to six cuts should be sufficient. The release cut is then made from the top, about $\frac{1}{2}$ " past the cuts towards the small end of the spring pole. Stand back and stay clear of the pole as the final tension is released.
2. Stand back at a safe distance and shave (or cut) with the compression arc of the spring pole, only cutting in the width of the saw chain. Once the spring pole starts to move, step away from it as it breaks. After the pressure is reduced, make the release cut in the tension side of the spring pole.

I. Sometimes a tree is suspended off the ground by the limbs underneath or by uneven terrain.

- The sawyer must decide whether or not to limb the tree after considering the potential that the sawyer might fall or that the tree may roll or collapse.
- Consider footwear and environmental conditions such as rain, snow, fog, or darkness, and the ability and experience of the sawyer.
- Carefully select the appropriate technique, such as limbing from the ground, limbing on top, or lowering the tree by bucking.

II. BRUSHING AND SLASHING

A. Sizeup and Safety Considerations

Many sawyers have cut their chaps or their legs when they took a step toward the next tree. Be sure the chain has stopped before moving to the next cutting location.

Engage the chain brake when moving even short distances. Never rest the bottom of the powerhead against the leg, only the powerhead's sides.

Shut the saw off when moving farther than from tree to tree, when hazardous conditions exist (slippery surfaces or heavy underbrush), and whenever moving more than 50 feet.

When slashing (felling) trees smaller than five inches in diameter, an undercut may not be needed. Instead, a single horizontal cut (kerf face) one-third the diameter of the tree may be used to fell it.

A good rule to follow is to undercut any tree that can't be picked up with one hand. When directional felling is necessary, use a conventional face cut (see the falling section).

Situations when directional felling of small trees should be used include:

- A potential barber-chair situation
- A closed canopy
- Tree defects
- Side binds
- Environmental damage

Other Safety Considerations—Always escape (retreat from) the stump quickly even when felling small-diameter trees. They can cause serious injuries and fatalities.

Trees should be pushed over only by the sawyer, only when the sawyer can do so safely, and only after the sawyer has looked up for overhead debris that could become dislodged.

B. Safe and Efficient Brushing and Slashing Techniques

In dense fuel accumulations, the tip of the guide bar may accidentally bump (stub) into a limb. The sawyer must continually be alert for kickback.

The sawyer normally will have a swamper (hand piler) working nearby helping to remove cut debris. The swamper's safety must be taken into consideration. It is the sawyer's responsibility to maintain cutting area control and to communicate their intentions to the swamper. A system of non-verbal communication must be worked out to ensure the safety of the sawyer-swamper team.

Proper stance and saw handling is imperative. In addition, the following steps should be taken.

- ***LOOK UP*** for widow makers and other loose debris. Do not cut under a hazard. Remove the hazard or move the cutting location.
- Watch out for whipping limbs and branches when cutting smaller material. Cut close to the stem. Begin and complete cuts with a sharp chain and high chain speed. Use eye protection.
- Cut limbs and stems flush with the trunk or close to the ground. Do not leave stubs (pointed stems) that could cause injury during a fall or cause the sawyer or others to trip.
- Do not cross the chain saw in front of your legs. Keep some distance between your legs and the guide bar. Bend down to maintain distance. Cut on one side, then the other to avoid crossing the chain saw in front of you.
- Never cut with the chain saw above shoulder height. Control is difficult when the saw's weight is above your shoulders. A thrown chain could strike you in the face or upper body.
- Clear debris from the cutting location to prevent the guide bar tip from stubbing it accidentally. When you are removing debris, engage the chain brake or turn off the ignition.
- Watch out for spring poles. Do not cut spring poles if you can avoid doing so.
- When cutting a heavy limb, consider using a small cut opposite the final cut to prevent the material from slabbing or peeling off.

- Pay special attention if you are working in close quarters with other workers in an area with steep slopes and thick brush or logging slash.
 - First, stop and size up the situation. Make a plan and talk it over with all workers in the area. A well thought-out plan saves time and reduces the risk of accidents.
 - After you have discussed the plan, work systematically from the outside in and from downhill up. This reduces the chance that material will hang up. Maintain a space between workers that is no less than two times the height of the tallest tree.
- You need one or more escape routes, even when felling small trees.
- School marm's (double stumps) are hazardous because they present a high potential for causing kickback. Watch that bar tip!
- When felling small trees, cut the stumps as close to the ground as possible without hitting the ground with the chain. Stumps are cut low so they will not be as noticeable and will present fewer hazards to people.
- Small trees can be limbed while they are standing. Do not cut with the chain saw above shoulder height. Limbing the bottom of small trees allows the sawyer to move in closer to the bole when felling it, and will help the sawyer watch the tip of the bar to prevent kickbacks.
- Draw the saw back towards you as you start the cut to maintain chain speed. Sudden stops to the chain near the tip often derail the chain from the bar.

- Remember, when you saw up from the bottom (using the top of the bar) the saw will push back rather than pull away. This increases the risk of kickback and loss of control. Be aware of signs of fatigue such as more frequent kickbacks, bar pinches, and near misses. Take a break at the first signs of fatigue.
- Cut pieces small enough so they are easy to lift and handle by hand. Lift properly using the legs and keeping the back straight.

Swampers must anticipate the sawyer's movement and the movement of the chain saw, be aware of their own footing and escape routes, and watch out for flying debris.

III. BUCKING

A. Proper Use of Dogs

Learn to use the saw's dogs as a pivot point when felling or bucking. Use the dogs to support the saw's weight. This technique will enhance your control of the saw and improve the saw's efficiency while reducing fatigue.

B. Bucking

1. Situational awareness
 - a. Never buck a tree that exceeds your ability.
 - b. Complete an overhead and ground hazard analysis.
 - c. Is the guide bar long enough for the log that is being bucked?
 - d. Establish good footing.
 - e. Swamp out bucking areas and escape routes. Anticipate what will happen when the log is cut.

- f. Plan the bucking cut carefully after considering:
- Slope: people and property in the cutting zone.
 - Tension: limbs and spring poles, side of log under tension and possible log movement after the release cut.
 - Compression: falling or rolling root wads, side of log under compression, possible movement as release cut is completed.
 - Rocks and foreign objects on the log. The log's tendency to roll, slide, or bind.
 - Pivot points: objects under the log that can allow it to swing around and strike the sawyer as the release cut is completed. Adjust the cutting plan to mitigate this hazard. Stand to the side of the cut to avoid the swinging end.
 - Ensure adequate escape routes are in place. Be aware of broken limbs, rocks or other objects hidden underneath the log that can roll up to hit the sawyer.
- g. Complete a hazard analysis prior to bucking:
- Assess the area for overhead and ground hazards to be mitigated before beginning bucking.
 - Special hazards like leaners and snags need to be taken care of right away. Drop hazard trees to the ground so no one has to work under them.
 - Size up the log for tension and bind, and possible reaction after the release cut has been completed.

- Establish escape routes and clear any obstacles that might inhibit your escape.
- Identify and mitigate spring poles.
- Cut slowly and observe the kerf for movement that will indicate where the bind is. A log can have different types of binds at different places.

2. Safe and efficient bucking techniques

In most situations it is safest to buck logs from the uphill side unless the log might move uphill when bucked. This could occur because of the log's position, weight distribution, and pivot points.

Always determine the number and type of binds and pivot points. Consult another sawyer if you have questions.

Begin bucking by cutting the offside first. This is the side the log might move to when it is cut, usually the downhill side. Cut straight down until you have space for a wedge.

Insert a wedge or wedges to prevent the cut (kerf) from closing tightly and pinching the bar.

Understanding directional pressures—or binds—is important for safe and efficient cutting. These binds determine bucking techniques and procedures. Look for landforms, stumps, blow-down, and other obstacles that prevent a log from lying flat, causing binds. When a bind occurs, different pressure areas result.

The tension area is the portion of the log where the wood fibers are being stretched apart. In this portion of the log, the kerf opens as the cut is made.

The compression area is the portion of the log where the wood fibers push together. In this portion of the log, the kerf closes as the cut is made.

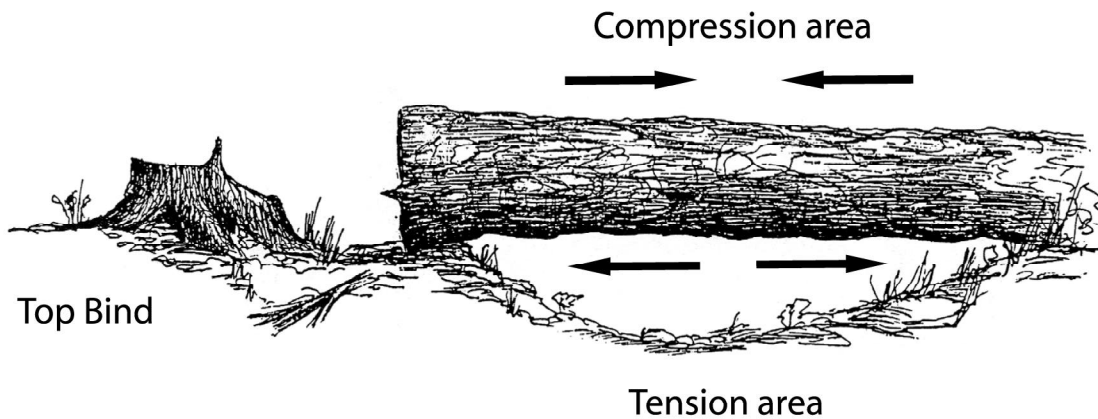
It is extremely important to determine where the log may move when it is cut. Inspect the log for all binds, pivot points, and natural skids. Various bucking techniques can be used to lower a suspended tree to the ground. Always be prepared for unanticipated movement of the log or round as the release cut is completed.



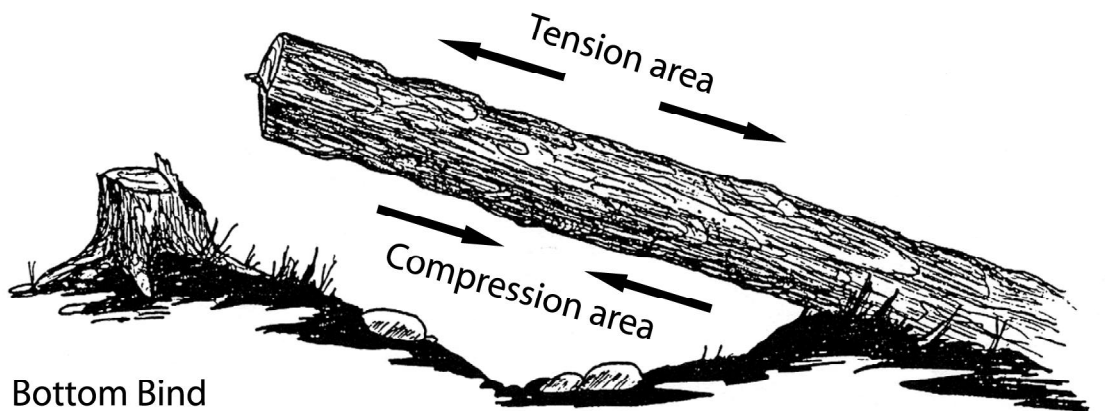
3. Determining bind

The four types of bind are: top, bottom, side, and end. There may be a combination of binds. Normally, logs have a combination of two or more binds.

- Top bind—The tension area is on the bottom of the log. The compression area is on the top.

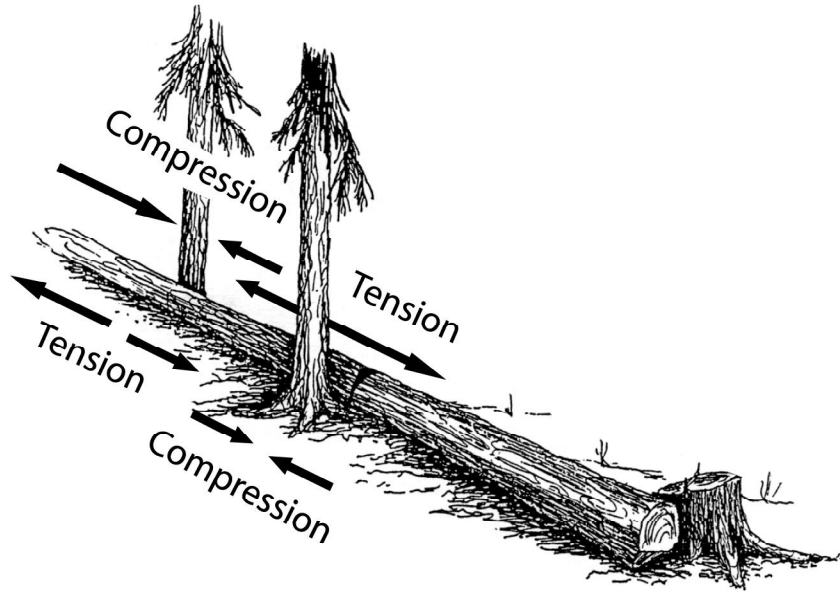


- Bottom bind—The tension area is on the top of the log. The compression area is on the bottom.

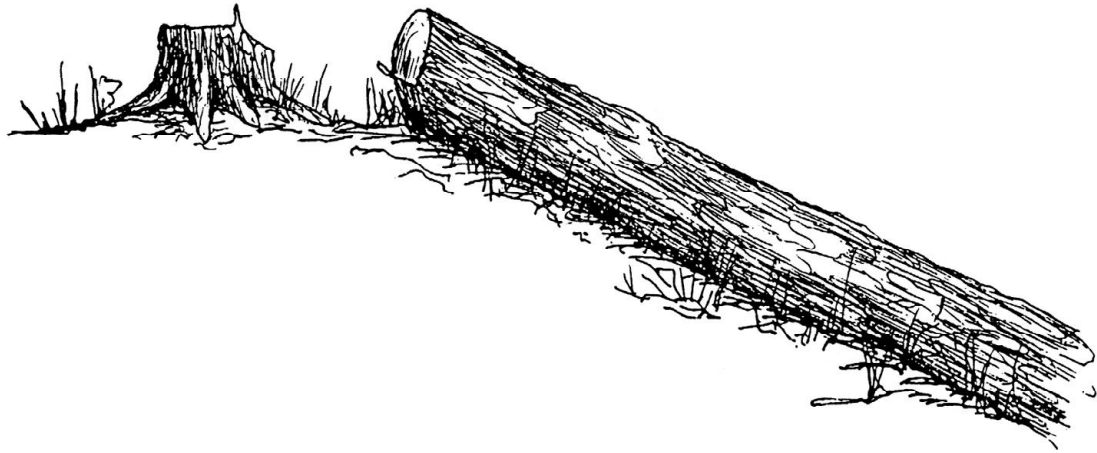


- Side bind—Pressure is exerted sideways on the log.

Side Bind



- End bind—Weight compresses the log's entire cross section.



Buck from the top down. It is best to start bucking at the top of the log and work toward the butt end, removing the binds in smaller material first. Look for broken limbs and tops above the work area. Never stand under an overhead hazard while bucking.

Look for small trees and limbs (spring poles) bent under the log being bucked. They may spring up as the log rolls away. If you can do so safely, cut these hazards before the log is bucked. Otherwise, move to a new cutting location and flag the hazard.



Determine the offside. It is the side the log might move to when it is cut—normally the downhill side. Watch out for possible pivots. Clear the work area and escape paths. Allow more than eight feet of room to escape when the final cut is made. Establish solid footing and remove debris that may hinder your escape.

Cut the offside first. If possible, make a cut about one-third the diameter of the log. This allows the sawyer to step back from the log on the final release cut, using only the forward portion of the guide bar. Do not let the tip of the bar pinch if the cut begins to close or to strike an object, causing kickback.

Watch the kerf to detect log movement. Position yourself so you can detect a slight opening or closing of the kerf. There is no better indicator of the log's reaction on the release cut. If the bind cannot be determined, proceed with caution.

It may be necessary to move the saw back and forth slowly in the kerf to prevent the saw from getting bound as the kerf closes behind the guide bar. Cut only deep enough to place a wedge. Continue cutting. Watch the kerf. If the kerf starts to open, there is a bottom bind; if the kerf starts to close, there is a top bind.

Reduce the remaining wood. Visually project the cut's location to the bottom of the log. Reduce the amount of wood for the final cut by cutting a short distance into the log along this line. Be prepared for kickback.

Determine the cutting sequence. The sequence of the remaining cuts depends on the type of bind. Generally, the next cut will be a small, less than 1½ inches wide, pie-shaped cut removed from the compression area. The log can settle slowly into this space, preventing dangerous slabbing and splintering. This practice is extremely important when cutting large logs.

The final cut, or release cut, will be made through the tension area. Because the offside has been cut, the sawyer only has to use enough bar to finish cutting the remaining wood. This allows the sawyer to stand back, away from the danger.

The location of the pie-shaped section and the release cut vary depending on the type of bind:

- **Top Bind:** Remove the pie-shaped section from the top, then make the release cut from the bottom.
- **Bottom Bind:** Remove the pie-shaped section from the bottom, then make the release cut from the top.
- **Side Bind:** If you are not certain the job is safe, do not make the cut. Normally, the offside is the side with tension; the tension side is usually bowed out (convex). Look for solid trees with no overhead hazards or other objects that you can stand behind for protection while cutting.

Remove a pie-shaped section from the compression area, then make the release cut in the tension area.

- **End Bind:** Cut from the top down, inserting a wedge as soon as possible. Finish by cutting down from the top. Watch the wood chips to make sure that the chain is not cutting in the dirt (look for dark or bark colored chips).

Pay special attention when bucking in blowdown. Blowdown is a result of strong winds that have uprooted the trees. At any time while the bucking cuts are made, the roots can drop back into place or the butt may roll. Consider the following points when bucking blowdown.

If possible, start limbing and bucking the blown down tree from the top and work your way toward the stump/root wad. Limb and buck observing normal assessments prior to beginning.

Try to work small sections at a time varying the length of each section based on the size of the tree being worked on. In general, the larger the diameter or length of the tree, the smaller the bucking section (keeping in mind the maximum size to make hand removal easiest).

Small trees growing on the roots of blow-down could be forced into the sawyer's position if the roots drop or roll. Cut the small trees off first. Limbs may be preventing the roots from rolling. Do not cut those limbs. The roots can move in any direction. Avoid standing directly behind or downhill from them.

4. Safe bucking practices

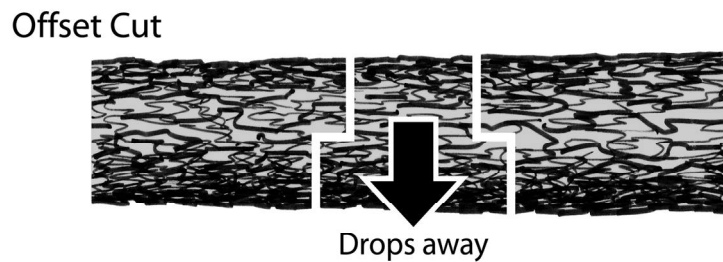
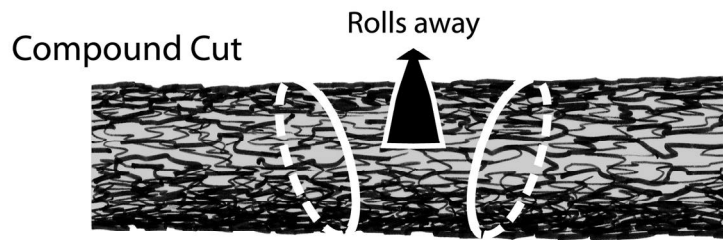
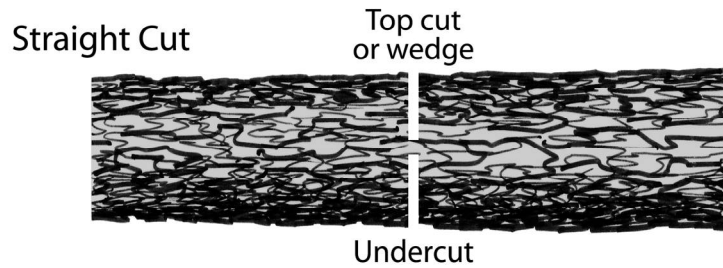
Warn workers that are in and below an active cutting area. Allow workers time to move to a safe location. Verify their safety visually and verbally, and get confirmation back. Announce when a bucking operation has been completed.

Never approach a cutting operation from below until the saw has stopped running, you have established communication with the sawyer, and the sawyer has granted permission to proceed.

When bucking on slopes, place a block downhill to prevent rollout of the cut portion.

Buck small sections that will be easy to control when they begin moving. Removing a single section of log may require that other binds be eliminated first.

Angle bucking cuts, wide on top and made on the offside, allow a single section of log to be removed. Angled cuts will permit the bucked section of log to be rolled away from the remaining log.



All logs must be completely severed when bucked. Flagging should be used to mark an incompletely bucked log as a hazard.

5. Points to remember

- Do a complete sizeup. Identify the hazards, and establish your escape routes and safe zones.
- Use rocks, stumps (if they are tall enough), and sound standing trees with no overhead hazards for protection in the event the tree springs sideways toward the sawyer when the release cut is made.
- Binds change with log movement. Reevaluation of binds is necessary as sections of the log are removed.
- Allow the saw to rest on log, using the dogs as a pivot point for each cut.

IV. BASIC FELLING

A. Situational Awareness

Analyze the felling job by considering:

Tree characteristics:

- Species
- Live or dead
- Sound or soft
- Diameter and height
- Widow makers and/or hangups
- Frozen wood
- Heavy branches or uneven weight distribution
- Direction of lean(s)
- Degree of lean (slight or great)
- Head lean or side lean
- Stand health

Soundness or defects:

- Deformities, such as those caused by damage from weather, lightning or fire
- Spike top
- Nesting or feeding holes
- Cat face
- Splits and frost cracks
- Twin or devil top, school marm
- Bark and trunk soundness
- Deformities, such as those caused by mistletoe
- Rusty (discolored) knots
- Punky (swollen and sunken) knots
- Unstable root system or root protrusions
- Wounds or scars
- Split trunk
- Human-made hazards

Analyze the base of the tree for:

- Thud (hollow) sound when struck
- Insect activity
- Conks and mushrooms
- Feeding holes
- Rot and cankers
- Bark soundness
- Shelf fungi or “bracket”
- Resin flow on bark
- A swollen base indicates potential for hollow bole in hardwoods

Examine surrounding terrain for:

- Steepness
- Stumps
- Irregularities in the ground
- Loose logs
- Draws and ridges
- Ground debris that can fly or kick up at the sawyer
- Rocks

Examine immediate work area for:

- People, roads, or vehicles
- Reserve trees (signed to mark administrative boundaries and location monuments)
- Power lines or fences
- Underground utility lines
- Structures
- Hang ups and widow makers
- Openings to fall trees
- Other trees that may be affected
- Snags
- Fire-weakened trees
- Other trees that may have to be felled first
- Hazards such as trees, rocks, brush, low-hanging limbs
- Footing

B. Sizeup

Before starting the saw, the chain saw operator must be able to evaluate if a tree is safe to cut. Other options are always available.

***IF FELLING A PARTICULAR TREE IS DANGEROUS,
DON'T DO IT!***

Debris falling from above causes over one-half of all falling accidents. Practice watching overhead while cutting, with occasional glances at the saw, the kerf, and the top of the tree.

Observe the Top - When you approach the tree to be felled, observe the top. Check for all overhead hazards that may come down during felling.

Look at the limbs. Are they heavy enough on one side to affect the desired felling direction? Are the limbs entangled with the limbs of other trees? If so, they will snap off or prevent the tree from falling after it has been cut.

Is the wind blowing strongly enough to affect the tree's fall? Remember that surface wind speeds are less than those 20' and above the surface. Wind speeds greater than 15 miles per hour may require that felling be stopped. Strong winds could also blow over other trees and snags in the area. Switching or erratic winds require special safety considerations.

Check for Snags - Check all snags in the immediate area for soundness. A gust of wind may cause snags to fall at any time, as may the vibration of a tree fall. If it is safe to do so, begin by felling any snag in the cutting area that poses a threat.

Swamp Out the Base - Clear small trees, brush, and debris from the base of the tree. Remove all material that could cause you to trip or lose your balance. Also remove material that will interfere with the saw, wedges, and ax. Look for small trees and brush that could accidentally stub the guide bar. Be careful not to fatigue yourself with unnecessary swamping. Remove only what is needed to work safely around the base of the tree.

Many fatalities have occurred because the sawyer did not move away far enough from the stump to avoid being struck or pinned.

Assess the Tree's Lean and the Soundness of the Holding Wood -

Most trees have two natural leans; the predominant head lean and the secondary side lean. The leaning weight of the tree will be a combination of these two leans. Both must be considered when determining the desired felling direction.

The desired felling direction can usually be chosen within 45° of the combined lean, provided there is enough sound holding (hinge) wood to work with, especially in the corners of the undercut.

Evaluate the tree's lean. With a plumb bob or axe, project a vertical line up from the center of the tree's butt and determine whether the tree's top lies to the right or left of the projected line. Always establish the desired lay based on the predominate lean while considering overhead and ground hazards.

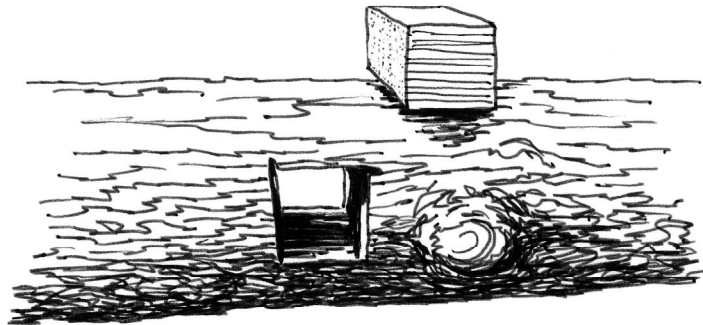


A pistol-grip tree may appear to be leaning in one direction while most of the weight is actually in another direction.

Look at the treetop from at least two different spots at right angles to each other. This will be done again in the sizeup process.

The importance of the hinge (or holding wood) cannot be overemphasized. Determine the condition of the tree's holding wood by sounding it with an axe. A sound tree will produce a "solid" sound. A soft tree will produce a "soft" sound or "thunk." Look up for falling debris while doing so.

Boring to determine a tree's soundness is an important technique, but it must be done properly because it has the potential for kickback. Using the guide bar tip, bore vertically into the area 90 degrees from the hinge behind the holding wood.



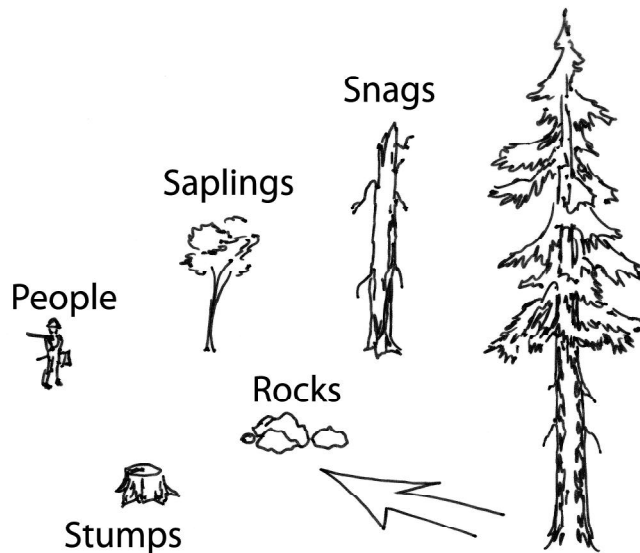
Do not weaken the holding wood by boring into or across any of the holding wood. The color of the sawdust and ease with which the saw enters the wood will be your indication of the tree's soundness.

Begin the boring cut with the power head lower than the tip of the bar. Apply full throttle and start cutting with the lower quadrant of the guide bar tip. Once the tip of the saw is in the tree, orientate the guide bar straight into the tree. Maintain full throttle throughout the boring cut. The left hand thumb must be wrapped around the handlebar.

Check for frost cracks or other weak areas in the holding wood. The desired felling direction can be adjusted to eliminate weaknesses in the holding wood. The depth of the undercut can also be adjusted (less than one-third the tree's diameter or greater than one-third) so that the holding area takes advantage of the soundest wood available.

C. Escape Routes and Safe Zones

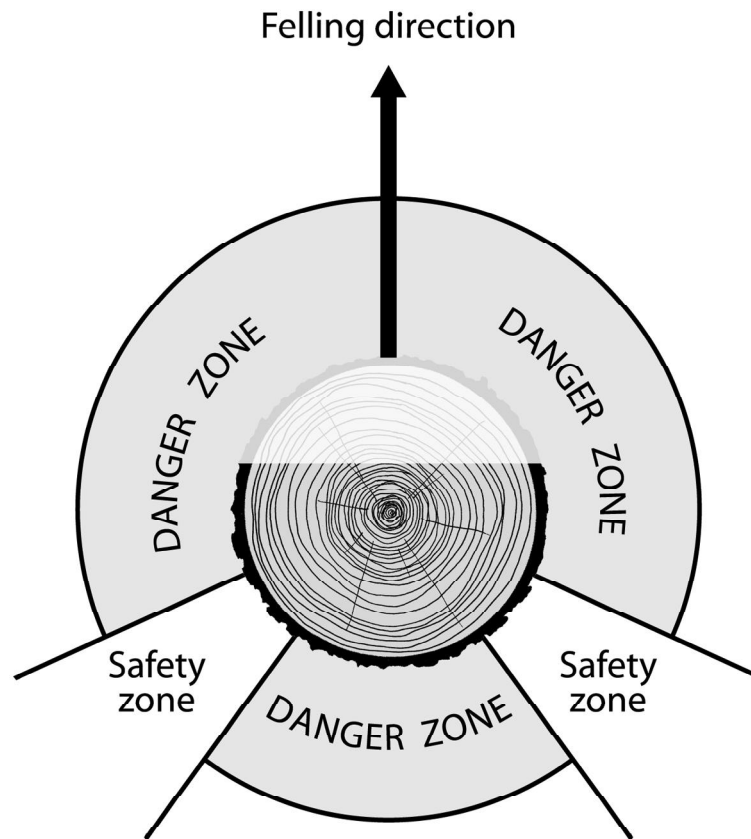
Walk out and thoroughly check the intended lay or bed where the tree is supposed to fall. Look for dead treetops, snags, and widow makers that may cause throwbacks, allow the tree to roll, or result in another tree or limb becoming a hazard.



The escape route and alternate routes must be predetermined paths where the sawyer can escape once the tree is committed to fall. Escape routes and safe zones should be no less than 20 feet from the stump and 45° to the sides and back from the direction of the fall. Sawyers must select and prepare the work area and clear escape routes and alternate routes before starting the first cut.

With the desired felling direction in mind, determine your escape route. Consider which side of the tree you will be making your final cut on and select a path that will take you at least 20 feet away from the stump when the tree begins to fall.

Do not choose a path directly behind the tree. It is best to prepare two escape routes in case you switch your location on the final cut.



Look for a large solid tree or rock for protection. The tree or rock must be at least 20 feet away from the stump and not be directly behind it. Make sure that debris that could trip you is cleared from the escape route. Practice the escape.

Walk out the intended lay of the tree. Look for any obstacles that could cause the tree to kick back over the stump or cause the butt to jump or pivot as the tree hits the ground. Look for any small trees or snags that could be thrown into your escape route.

Using the observations you made walking out the lay, reexamine the escape route. Be sure that your chosen route will be the safest escape **before** you begin to cut.

D. Observers and Spotters for Felling Operations

The use of personnel other than swampers in felling operations continues to be controversial. The USFS *Health and Safety Code Handbook* states that if you choose to have additional personnel (such as during training), justification for the additional personnel and the implementation process shall be documented in the JHA.

The Fireline Handbook requires a spotter for all fireline felling operations. The wildland fire chain saw operator must always work in a team of two in order to summon help in case of mishaps.

The additional sawyer or swamper can assist in cutting area control and operational analysis, but once the cutting operation begins, **the reliance on the team member to warn the operator, that is as a lookout, is an unsafe practice.**

This practice is unsafe for two primary reasons:

- Possible temporary distraction of the lookout (wasps, fire runs, aerial activity) could leave the sawyer vulnerable at a critical moment.
- Relying on a lookout's warning often leaves the sawyer inattentive to their own safety.

Even as the lookout observes a hazard to the sawyer, there is no effective method to deliver a warning to the sawyer to escape in sufficient time.

Once the sawyer is committed to the backcut their total attention must focus on safely completing the cut, and cannot be distracted by lookouts or concerns over their location.

Often you may hear an argument for a lookout as a wedge driver for the fatigued or fatiguing sawyer. **WRONG!** The chain saw should be out of the sawyers hands long before then.

Check to be sure the cutting area is clear of people. If a swamper or falling boss is present, they must remain no less than two tree lengths away from the tree to be felled.

Brief the swamper to assist with cutting area control to prevent other workers from entering the falling area.

E. Felling the Tree

“Face” the tree. The face is made in the direction you want the tree to fall. Estimate one-third of the tree’s diameter, shout a warning, and proceed with the undercut. While cutting, glance at the tree’s top for falling debris. When finished, check the direction the tree is faced. If the face is not in the desired felling direction, correct the cut.

Shout a warning. Shut off the saw and shout to be sure that the cutting area is secure. Reexamine your primary and secondary escape routes before beginning the backcut.

Complete the backcut. Remembering the importance of hinge wood, stump shot and wedging, complete the backcut.

Escape (or retreat) the stump. When the tree commits to the fall, rapidly follow your escape route. Do not hesitate at the stump. If the saw becomes stuck, leave it. If carrying the saw prevents you from escaping quickly enough, drop it!

Keep your eyes on your predetermined escape route and on the falling tree. If the felled tree strikes other trees, they may still be moving after the tree has fallen. Watch for flying limbs and tops. Remain in your safe zone until it is safe to approach the stump.

Analyze the Stump. The stump gives the best critique of the felling operation. Before approaching the stump, look in the tops of the surrounding trees for new overhead hazards.

Take time to analyze the felling operation:

- Is the hinge wood even across the face of the tree?
- How much holding wood is left on each corner?
- Is the stump shot sufficient?
- Were the cuts level?
- Check the stump height and look for stump or root pull and dutchman cuts. Did the tree fall to the desired lay? How far from the center of the predetermined lay is the top?

F. Felling Details

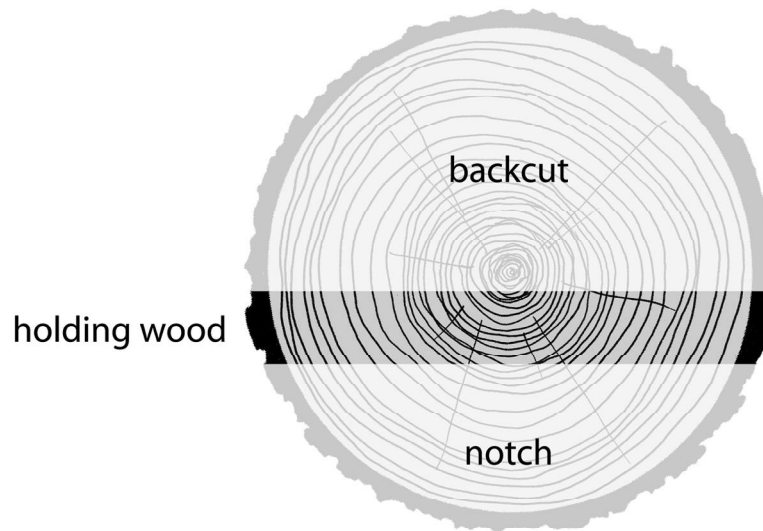
Proper evaluation of a felling operation requires a thorough understanding of the mechanics of the undercut, hinge/holding wood, backcut, and the felling procedure. In addition, the sawyer needs to consider the various problems the individual tree presents.

Every tree should be evaluated or sized up using techniques discussed in the Situational Awareness-Individual Complexity Checklist.

1. The undercut, holding wood, and backcut

The three basic face cuts are the conventional undercut, the Humboldt, and the Open-face Notch. We are only going to discuss the conventional undercut due to its broad application for all timber types and because it provides a solid foundation from which to learn additional cutting techniques.

The best way to envision these cuts is by the use of a rectangle that extends through the tree. The bottom corner is the back of the face's horizontal cut. The opposite upper corner will be the back of the backcut.

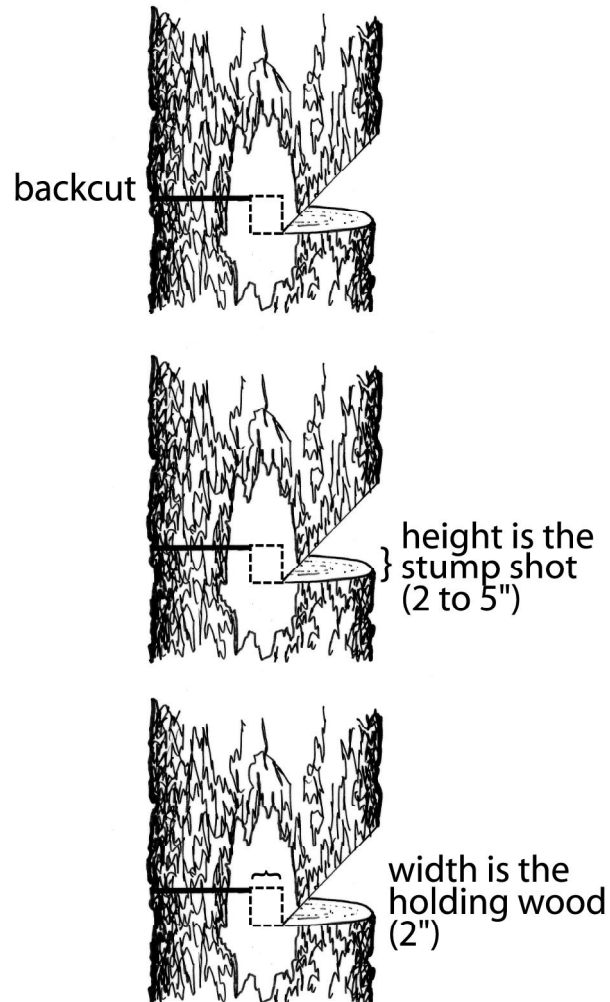


The height of the rectangle is referred to as the stump shot. It is an anti-kickback device to prevent the tree from kicking back over the stump if it hits another tree during its fall. This is especially important when felling trees through standing timber.

The width of the rectangle is the holding wood. As the backcut is made, the sawyer must be careful not to cut this wood. Maintaining the holding wood is the key to safe and effective felling.

It takes three cuts to fell a tree. Two cuts form the undercut (or face cut) and the third forms the backcut. The correct relationship of these cuts results in safe and effective tree felling.

Before discussing the felling procedure, we will analyze the mechanics of the felling cuts. Undercutting and backcutting construct the hinge that controls the direction and fall of the tree.



- a. The undercut serves two purposes:
- First, it directs the tree to fall in the chosen path by removing the tree's support in the direction of the face cut.
 - Second, it enables control because hinge determines how far the tree will fall before breaking the hinge wood, guiding the tree to the intended lay.

The undercut consists of two cuts: a gunning or horizontal cut, and a sloping cut. Observe overhead hazards and look up often during the undercut.

You should be standing all the way up, with the saw comfortably held at waist level. If slope or other factors prevent standing, body position should be down on one knee.

The tree is faced in the general direction of the tree's predominate lean. Ideally, the undercut is made in the same direction as the tree's lean, but because of structures, roads, other trees, or trails, the desired felling direction may be to one side or the other of the lean. Normally, the desired direction is less than 45° from the lean.

After selecting the desired felling direction, estimate one-third the tree's diameter, and mark the hinge wood rectangle in the tree. If the tree has thick bark, remove it from an area on both sides of the tree along the plane of the gunning cut. The bark can be removed with the falling axe or with the chain saw. Use caution in case the axe glances off the bole or the saw kicks back.

Set the saw's dogs at the bottom corner of the hinge rectangle, and begin the horizontal cut.

The gunning cut is a level cut. This cut is made at a height comfortable for the sawyer, usually at standing waist height. The gunning cut dictates the direction of fall if the relationships of the three cuts are maintained. *If there is any danger from above, such as snags, the cutting should be done while standing so the sawyer can watch the top and escape more quickly.*

The specific direction of the undercut is determined by “gunning” the saw. Look down the gunning marks on the saw and align them parallel with the desired felling direction. After the gunning cut has been made level to at least one-third of the tree’s diameter, the horizontal cut is complete.

Short snags sometimes require an undercut deeper than one-third the tree’s diameter to offset the tree’s balance. Trees with heavy leans may not allow the sawyer to make the horizontal cut as deep as one-third of the tree’s diameter without pinching the guide bar.

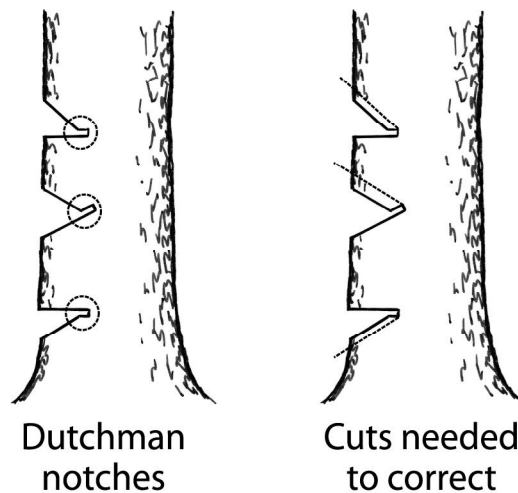
The sloping cut needs to be angled so that when the face closes the tree is fully committed to the planned direction of fall. As the face closes, the hinge/holding wood breaks. If this happens and the tree is still standing straight, the tree could fall away from the predetermined lay.

As a general rule, make the sloping cut at a 45° angle. Remember that it is important that the face not close until the tree is fully committed to the planned direction of fall.

Start the cut above the top corner of the hinge on the face side and draw the saw down to the corner of the gunning cut. Allow the chain to stop, leave the bar in place in the cut, pull the saw back and sharply force the dogs into the trunk. This will maintain the angle of the sloping cut across the face of the tree.

Line up the sloping cut with the gunning cut so that they meet, but do not cross. When the cuts cross, a “dutchman” is formed. If the tree were felled with a dutchman, first the dutchman would close, then the tree would split vertically (barber-chair), or the hinge wood would break off unevenly. Felling control would be lost. A weak tree might snap off somewhere along the bole or at the top.

It is difficult to make the sloping cut and the horizontal cut meet correctly on the opposite side of the tree. This is because the point of intersection is not immediately visible to the sawyer.



After making a short sloping cut, leave the saw running in the cut. Engage the chain brake. Go around to the off side of the tree and see if the guide bar is in the correct plane to intersect the back of the horizontal cut.

Keep your hands away from the throttle trigger. If the gunning cut cannot be easily seen, insert a clean stick in the off-side gunning cut as a reference marker.

Look down through the top of the bar to determine if the bar and stick are properly aligned at the 45° angle. If they are not, estimate the correct angle and adjust the bar angle to achieve the correct sloping cut. Practicing on high stumps will help you become skilled at lining up these cuts.

- b. The hinge, or holding wood, is the wood immediately behind the undercut (notch). The gunning and sloping cuts **must not** overlap each other. If they do, the undercut must be cleaned up so no dutchman is present.

The corners are the holding wood at the ends of the face cut, in the first 2 to 8 inches inside the bark. The horizontal and sloping cuts must not overlap in this portion of the undercut, creating a dutchman.

Care must be taken not to cut the undercut too deeply while cleaning up. This reduces the amount of room available for wedges in the backcut.

If cleaning up the sloping cut will create too deep an undercut, stop the sloping cut directly above the end of the horizontal cut.

The undercut needs to be cleaned out. Any remaining wood will cause the face to close prematurely and the holding wood will be broken behind the closure.

Once the face has been cleaned, recheck the felling direction. Place the dogs back in the holes left while making the gunning cut and check the gunning marks or place an axe head into the face and look down the handle.

The gunning sights can be used in reverse to help determine the guide bar's position. The back of the undercut should be perpendicular to the desired felling direction.

If the tree is not aimed in the direction that you want it to fall, extend the horizontal and sloping cuts as needed, maintaining a single plane for each of the two cuts.

c. Backcut and wedging procedures

The third cut needed to fell a tree is the backcut. The relationship of this cut to the face is important for proper tree positioning and the sawyer's safety.

The backcut can be made from either side of the tree if the saw has a full-wrap handlebar. Choose the safest side to cut on.

In the area where you have removed the bark for marking the falling rectangle, place the dogs so the chain will cut no closer than 2" from the face and 2" above the gunning cut.

For large diameter trees the backcut may have to be as much as 5" above the horizontal cut to ensure adequate stump shot. You may place the dogs closer than 2" on small trees (less than 10" dbh) with lightweight tops.

Give a warning shout before starting the backcut. Start the backcut with the dogs placed so the chain will end in the upper corner of the hinge wood rectangle.

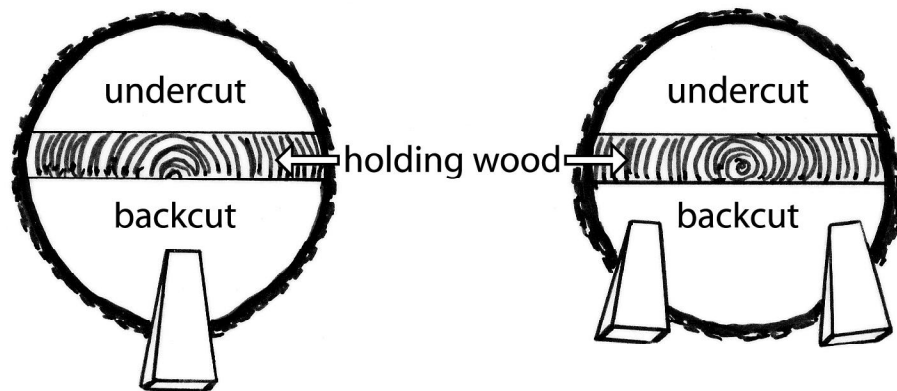
Hold the saw level so that the backcut will be level when the cut is complete. Ensure that when the cut is finished it will line up with the top corner of the opposite end of the rectangle. If the cut is angled, wedging power and/or the stump shot's height will be altered.

It may be helpful to cut or chop the bark to help level the bar. Do not cut deeper than the bark. Cuts into the wood will eliminate or reduce wedging lift. Once the backcut has been made into the wood, do not change the backcut's location.

Keep at least three wedges and an axe readily accessible while making the backcut. The wedges should be in a wedge holster worn on the chap's belt or in a pants pockets.

Keep the axe within arm's reach. The size of the wedge depends on the tree's diameter. For a 24" tree, two 10-12" wedges and one 4-6" wedge is a good combination.

Remove thick bark immediately above and below the backcut's kerf where wedges will be placed. The bark will compress, lessening the lifting power of the wedges. The wedges should be spread to better stabilize the tree in case of erratic winds.



If there is any wind at all, at least two wedges are recommended. The second wedge adds stability. With only one wedge, the tree can set up a rocking action between the holding wood and the wedge. If a strong wind begins to blow, the holding wood can be torn out.

2. Directional felling

Place wedges in the kerf in each area as soon as the bar's travel will permit. Place the wedges parallel to the desired felling direction. Do not drive the wedges too hard. They will interfere with the backcut or cause the tree to become a heavy leaner.

Watch for droop in the wedges as the backcut progresses, and occasionally try to push them in with your hands. Retighten them with the axe every 4 to 6" of cutting.

Be careful not to drive the wedges too hard. They may bounce out of the kerf, cause the hinge to break prematurely, or the pounding may set up a dynamic response in the tree, causing material to fall on the sawyer.

The wedges are there in case the lean was incorrectly established, the wind causes the tree to set back, or the sawyer intends to fell the tree in a different direction from the tree's natural lean.

As you cut, continually look above for possible hazards and at the kerf for movement. **Do not cut into the holding (hinge) wood.**

With the correct lean established and the proper relationship between the three cuts, the face will begin to close and the tree will fall in the planned direction.

3. Wedging small diameter trees

Wedges must be used for all felling operations. Small trees limit the sawyer's use of wedges, even when small wedges are used. A technique can be employed where half of the back cut is made at a time. This allows for wedges to be placed without interfering with the guide bar.

It is desirable to use a chain saw equipped with a full-wrap handlebar, making it easier to use the bottom corner of the guide bar tip, reducing the chance of kickback.

After making the undercut, cut half of the backcut using the guide bar's tip. Make this cut from the tree's offside. Watch out for kickback and be careful not to cut the holding wood.

Finish the backcut from the other side. Leave the appropriate amount of holding wood across the tree, depending on diameter 1 to 1½ inches of holding wood.

After removing the saw, place a small wedge in the kerf an inch or more from the remaining wood to be cut. Remember to keep the wedge tight but do not drive the wedge too hard.

Finish the backcut using the tip of the guide bar, being prepared for kickback from the wedge. The wedge will be in position if the tree sits back. If two wedges are needed to lift the tree into the undercut, spread them as widely as possible.

For trees that have a moderate amount of side lean, two wedges may be inserted on the side of the backcut that has been cut first. As with other wedging operations, it is essential to tighten the wedges often, especially on trees that are attempting to sit back.

A sitback is a tree that settles back opposite the intended direction of fall during the backcut. This normally happens because the lean was incorrectly established or the wind changed direction.

If the sawyer has been following the proper felling procedure (there is a wedge in the backcut and the holding wood has been maintained), a sitback can be dealt with readily.

If the proper felling procedure has not been followed, the sawyer will need assistance because the tree has probably pinched the bar.

Immediately notify your supervisor in the case of sitbacks and other felling difficulties to determine methods and skill level required to resolve the problem.

Before you leave a hazard tree, be sure to clearly mark the area with flagging or with a written warning. Give a verbal warning to others working in the area.

4. Falling snags

Remember: **Stay within your skill level.** If a falling task exceeds your skill level or your “gut” is uncomfortable, refuse the falling assignment and request a qualified faller for the task.

A snag is a standing dead tree, or portion of a tree. They may be either sound (recently dead or the integrity of the wood fibers is intact), or soft (the wood fibers have decayed and the snag is punky).

Shout a warning. Before working on a snag, everyone in the area must be notified. Remember a snag can fall in any direction at any time.

Observe the top. Pay special attention to overhead hazards, branches, and the snag’s top. Upper limbs may be weak and ready to come down at the least vibration.

Never cut directly below a hazard. Look up while driving wedges.

Swamp out the base. Carefully check the condition of the bark on the snag. Loose bark can come sliding down the side of the snag and presents an extreme hazard to the sawyer. Standing back with room to escape, remove loose bark at the snag's base by prying it with an axe or a pole. Do not chop the bark, because this would set up vibration in the snag.

Size up. Check the condition of wood by boring into it with the bar tip. Maintain the integrity of the holding wood. When sounding with an ax, look up while striking the tree. Check for frost cracks and other splits in the holding wood.

Determine two escape routes. Since the holding wood is rotten to some degree, you must establish two routes of escape. The gunning sights can be used in reverse to help determine the guide bar's position.

Select the appropriate lay. **Do not fell a snag against its lean.** Make the undercut and the backcut while standing upright. You are in a position where you can easily look up, and less of your body is exposed to falling debris. In addition, you are in a position that allows immediate escape.

When you are cutting the face, be alert for the snag pinching the bar. Previous boring in the undercut area during sizeup should alert you to this possibility. Moving the bar back and forth will minimize the possibility of pinching.

If the snag starts to sit on the bar, finish the undercut just to that depth. It is critical that the undercut has a wide opening and that it be cleaned out from corner to corner.

A short snag, with few or no limbs to give it lean, may need a face up to one-half the snag's diameter to offset the balance. Always flag any tree too dangerous to fall.

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Unit 4 - Fireline Construction and Mopup

OBJECTIVES:

Upon completion of this unit, the student will be able to:

1. Demonstrate the tactical application of chain saws in fire line construction and mopup operations.
2. Define the duties and responsibilities of the chain saw operator and the swamper.
3. List four methods of removing cut debris.
4. Demonstrate methods of saw team deployment for fireline tactical strategy.
5. Define tactics for coordinating multiple saw teams.

I. DUTIES AND RESPONSIBILITIES OF THE SAW TEAM

A. Chain Saw Operator

1. Stays alert to surface fire spread and location.
 - a. Establishes positive communication with swamper, own crew, adjoining resources and supervisor.
 - b. Ensures LCES is in place.
 - c. Establishes cutting area control, ensuring no one is working below any bucking area, no one is within two times the height of any tree to be felled. “A distance of greater than two tree lengths shall be maintained between adjacent occupied work areas on any slope where rolling or sliding of trees or logs is reasonably foreseeable.” (OSHA 1910.266)
 - d. Applies appropriate line construction standards for fireline width, limbing height, safety zones and MIST. This includes applying the direction found in the Incident Action Plan, or specific instructions from operations section overhead.
 - e. Sets crew’s fireline construction work pace.
 - f. Cuts material to size moveable by hand.
 - g. Safely moves between cutting locations.

2. Creates cut material disposal sites.
 - a. Site location decision is based on ease of disposal, line construction standard.
 - b. Windows - natural openings in the fuels used as cut material disposal sites.
 - c. Keyholes - openings cut into continuous fuels used to dispose of cut material.
 - d. Banking - stacking of cut material on the side of the fireline opposite the fire edge.

Caution should be used regardless of disposal method selected to avoid creating fuel jackpots with the potential to add to fireline intensity in the event of spotting.

B. Swamper/Brush Puller

1. Assists with cutting area control and establishing fireline.
 - a. Maintains LCES.
 - b. Communication link for saw team by monitoring radio and assisting sawyer with cutting area control.
 - c. Clears fireline as escape route.
 - d. Brush/slash removal.
 - e. Maintains fireline quality control standards.
 - f. Identifies and improves safety zones.
 - g. Identifies the need for or release of extra pullers.

- h. Carries scraping tool, saw fuel, falling axe and kit for sawyer.
 - i. Flags escape routes and safety zones.
- 2. Moves cut material along fireline by:
 - a. Dragging - removing cut fuels away from fireline edge by dragging.
 - b. Chaining - removing cut fuels into windrows away from the fireline perpendicular to the slope.
 - c. Banking - placing cut material against the opposite side of the fireline.
 - d. Throwing - removing cut fuels by throwing them away from the fireline. To avoid adding to fireline intensity do not dispose of cut fuels within the fire.

II. TACTICAL CONSIDERATIONS

A. Topographic Considerations

Terrain will often dictate line location, cutting area control, escape routes and safety zones.

When cutting uphill fireline ensure workers below the cutting area are warned and clear of bucking and falling operations to avoid being struck from rolling or sliding rounds and trees.

Apply the Downhill/Indirect Line Construction Guidelines (IRPG or Fireline Handbook PMS 410-1). Consider completing the minimum fireline required to stop fire spread, then returning to remove larger material to avoid accidents from rolling or sliding hazards.

Under/overslung (sidehill) fireline requires the same cautions as above for cutting area control and safety.

B. Tactical Considerations

Avoid any unnecessary falling. Identify and remove by falling only those trees which present a real hazard based on their condition:

- On fire
- Unsound snag or live tree
- Severe lean
- Hang up

Fire weakened trees should be identified and removed as soon as practical. Extra care should be taken in assessing the condition of the tree, particularly the hinge/holding wood.

Always fall fire weakened trees with their predominate lean. If the tree's complexity exceeds your comfort or skill level, flag the hazard area.

Hang up trees greater than 16-20 inch diameter are particularly hazardous to remove by chain saw. If possible use mechanized equipment (dozer, track hoe, skidder, winch from engine) to remove them. Otherwise, flag the hazard area.

Never fall at night or when smoke obscures the top of the tree preventing proper assessment. **Night falling is forbidden.**

Pay attention to fire behavior, including spotting by wind, convection, gravity, and careless debris removal while locating and constructing the fireline.

C. Minimize Suppression Impacts

Employ Minimum Impact Suppression Tactics (MIST) such as angle bucking logs to allow sections to be rolled back into their natural position after mopup, flush cutting stumps, or locating fireline away from larger fuels.

In wilderness area avoid all tree falling and bucking unless it is the minimum necessary action to achieve fire management objectives. Alternative tactics (utilizing water, line location using natural openings) that minimize long term disturbance of natural conditions are always preferred in wilderness.

III. TACTICAL DEPLOYMENT

A. Direct Attack/Hotline

Tactical line location depends on topography, fuel type, and fire behavior. Only cut enough vegetation to control the fire. This lessens exertion and exposure time, and increases line production rate. Direct attack is the first tactical choice when fireline intensity is low enough to permit it.

Cut debris should be moved immediately to prevent surface fire spread. A firefighter with shovel should be a part of the saw team. Any hot debris must remain within the fireline to prevent loss of fireline control.

Locate fireline and remove larger fuel to minimize fireline intensities for following firefighters.

Swampers should stay alert for spotting, identify escape routes and the need for safety zones as the line progresses.

B. Indirect/Parallel Attack

Indirect attack is frequently required in heavy brush or in timber with a heavy dead/down component where high fireline intensity or frequent spotting prevents direct attack. Ensure LCES is in place and followed.

1. Apply the Downhill/Indirect Line Construction Guidelines (IRPG or Fireline Handbook PMS 410-1).
2. Holding difficulties often require a change in tactics to indirect or parallel attack. Communicate with adjoining crews and your supervisor when tactics are modified.
3. Crown fires often require removal of the canopy along the fireline to stop them. A minimum canopy clearance of 18 to 20 feet is required to prevent independent crown fire spread. A reduction of ladder fuels is also necessary to prepare indirect fireline from later crown fire activity.

Because the work load is significant, multiple saw teams, crews and mechanized equipment may be working together to establish an adequate fireline. Thorough planning and extra coordination is required to maintain cutting area control for each saw team in this situation.

C. Initial Attack, Single Crew Tactics

Small initial attack fires with a limited number of personnel to support containment efforts requires good situational assessment and preparation prior to departing the vehicle. The sawyer and swamper should each carry a hand tool in addition to the chain saw, saw kit and fuel, falling axe and wedges, PPE and radio.

Containment of single tree fires often requires an adequate line be anchored and constructed to contain spread, and a bed prepared to drop the tree into for extinguishment. Drop the tree or snag as soon as possible to limit the chance of spots being thrown past the constructed line.

Containment of brush fires with limited resources may require that the swamper not only assist with brush pulling, but support digging line too.

D. Large Fire Tactics

Saw team deployment is either progressive or leap frog.

- Progressive - Each saw team cuts a swath of fireline, with the lead team only cutting enough fuel to pioneer the fireline and following saw teams and hand tools completing the fireline to standard.
- Leap Frog - The saw team cuts a chain of fuel then bumps a chain ahead, followed by hand crews to complete the fireline. Works well in light fuels or during mopup.

The leap frog technique is not advised when working in timber or heavy brush where the potential to exceed the safety of a retreat to the black or a safety zone exists. When the leap frog method is used, lookouts are essential to maintain safety.

E. Cold Trail

Because the fire has passed or has only burned sporadically throughout the fuels, cold trail chain saw work is less intensive than hotline. Cold trail involves each saw team using the leap frog method to increase productivity. Used where fire line is inactive and as little fuel as possible needs to be removed.

- Fireline width can generally be kept to a minimum. The exception is in fuels with a potential for reburn, such as Gambel's oak, where removal of a wider swath of fuel will reduce slopovers from radiant heat or spotting.
- When reasonable, straighten out fire fingers by adequate fire scouting, cutting only access trails for "feeling out" the edge. Fire fingers should be tied together when possible and burned out to reduce the length of the final fireline to be mopped up.
- Identify and mitigate overhead and ground hazards along the fireline that may be present.

IV. COORDINATION

On small incidents, coordination of tasks on the fireline is less complex and generally direct from person to person.

On large incidents with more resources and greater distances, the complexity of tactical deployment increases.

- Communications - tactical and command
- Spacing - saw teams, crews, mechanized equipment
- Deployment variations
- Flagged fireline
- Tie-ins
- Fueling
- Break downs
- Ordering fuel, oil, chain saw parts
- Incident issued chain saws from kits should be thoroughly tested before leaving camp.

V. MOPUP

The saw team's duties are to assist crews in mopup operations and to mitigate aerial hazards. They accomplish this by:

- Hazard tree identification and removal, or avoidance by flagging the hazard tree zone.
- Facilitating crew access by opening burning logs, limbing, bucking downed trees, flush cutting stumps, cutting access trails for crews, equipment and hose.
- **Mopup is not a time for sport falling.** If it is not safe or necessary do not fall any tree.
- Mopup is a time for added vigilance to hazards, not complacency. Spend more time on safety briefings, ensuring hazard analysis is objective and thorough, and communications are maintained between personnel.

VI. FIRELINE REHABILITATION

Fireline construction often creates considerable environmental disturbance that must be corrected. In addition to the hand tool practices of pulling berms back into cut fireline, it is often necessary to employ branches, limbs and bole wood to stabilize the fireline to prevent erosion. If adequate material for fireline rehabilitation is not present, saw teams may be called upon to provide the material.

Consideration should be given to avoid “clear cutting” an area. Instead material should be cut from widely spread locations to minimize visual and environmental impacts.

Larger material is often used to divert water away from the disturbed soil along the fireline. Large limbs and logs may be needed to stabilize underslung line or to create check dams in drainages.

Contour, or cross-slope, and falling of dead trees is frequently employed to stabilize soil along contours. The logs are staked in place and backfilled on the uphill side to collect soil and water to lessen slope erosion.

Contour falling requires technically advanced skills and should not be attempted by apprentice sawyers.

In wilderness areas, techniques such as contour felling or cutting and bucking material for rehabilitation operations, are generally not appropriate (unless there are no other less-impacting options).

Other techniques are preferred, such as returning any cut material to its original location and, if necessary, establishing log erosion control structures by making use of existing down woody material.

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Unit 5 - Field Proficiency

OBJECTIVE: Upon completion of this unit, the student will be able to:

Demonstrate competence in safely limbing, brushing, bucking and falling in least complex situations.

I. INSTRUCTOR'S RESPONSIBILITIES

The instructor must take an active role in training and evaluating the students. Instructors need to demonstrate the skills properly and work with the students to ensure that they gain the skills needed to operate chain saws safely.

The instructors will make honest, constructive assessments when evaluating students to assist the student in improving their performance. The instructor is responsible for documenting that the students have the skills to do the work safely. If they don't, the instructor should document the additional training needed on the student's Chain Saw Operator Field Evaluation form.

II. STUDENT RESPONSIBILITIES

During the field training sessions, safety should be the number one concern of instructors and students. Something can always go wrong during skill-related training.

- Take responsibility for your own safety, for the safety of the other students and the instructors.
- Demonstrate cutting area control. Make sure you verbally communicate to the instructor what you intend to do before you do it. This is a critical component of your evaluation.
- If you do not fully understand a task, seek clarification. The instructor is there to help you succeed.
- A job hazard analysis that includes first aid procedures and emergency evacuation plans will be prepared in advance and discussed with the students. Use the hosting agency's safety and health handbook and safety information in this unit to help develop these plans.
- Actively participate in the tailgate safety session that includes all safety aspects of the field proficiency exercises, first-aid procedures and emergency evacuation plans.

- Ensure that you have all safety items listed on the Chain Saw Operator Field Evaluation form (Appendix B). Any safety item found missing by the evaluator will result in failure.

Students must understand that further training may be required before sawing in different regions because of the differences in tree species, wood properties, tree sizes, and topography.

A. Personal Protective Equipment

- Hardhat
- Eye protection
- Hearing protection
- Gloves (cut resistant for chain filing)
- Long-sleeved shirt
- Chain saw chaps (chaps should overlap boots at least two inches)
- Heavy-duty, 8" high leather boots with nonskid soles

B. General Equipment

- First aid kit
- Fire extinguisher
- Proper chain saw for the job (a full-wrap handlebar is recommended for felling)
- Fully operational chain brake
- Chain (correctly filed and maintained)
- Chain saw wrench (Scrench)/Torx wrench
- Approved safety container for fuel
- Chain and bar oil container (clearly marked)
- Proper wedges for the work project (wooden wedges are prohibited)
- Single-bit ax or maul (3 to 5 pounds)

The instructor will enforce cutting area control for their group and between groups. Be aware of the activities taking place in all cutting areas and ensure that you follow correct safety procedures at all times.

Many safety issues are specific to tree felling. You will be asked to verbalize and demonstrate the procedural approach to felling. Students and instructors should verbalize correct safety procedures at all times.

To ensure correct felling procedures are followed, a fully qualified instructor must be at the base of the tree within a few feet of the sawyer to monitor the felling process to prevent accidents.

III. CONDUCTING FIELD TRAINING FOR SAWYERS

A. Secure Felling Area

Many safety issues can be addressed by establishing a secure felling area. A secure felling area must be identified and managed.

- The area needs to be no less than two times the height of the tree being felled, in all directions.
- On hillsides with steep slopes, the entire downhill side will be included in the secure area.
- No one shall be allowed in the secured felling area without authorization by the sawyer and instructor.
- A safety zone will be established outside the secure area. Everyone must remain there until all felling is completed and the sawyer has shouted *ALL CLEAR*.
- Whenever practical, the safety zone should be opposite the direction of the planned fall, and no less than two times the tree's height from the tree being felled.
- One person shall be responsible for maintaining reliable communications with the sawyer and with people in the safety zone to ensure that no one enters the secured felling area.

- A road or trail guard will be set up on all roads and trails entering and leaving the secured felling area. This will prevent members of the public or other employees from entering the area. Effective communication must exist between the guards and the sawyer.
- Before leaving the secured felling area, the sawyer needs to ensure that no hazards remain (such as hangups, unstable logs, or other dangers).

To protect the lives of employees, contractors, and the public, the sawyer must adhere to these standards. Supervisors and all employees must understand and follow these standards.

B. Monitoring Cutting Procedures

The instructor will monitor cutting procedures and take corrective actions or discontinue cutting if problems develop. Common problems include:

- Inaccurate gunning (sighting) that may cause the tree to fall in the wrong direction or get hung up in another tree.
- Too deep an undercut that may cause a tree to go over backwards or fall before the undercut is complete.
- A potential barber chair. Recognize this situation before it occurs.
- Accidental or intentional removal of all or part of the holding wood.
- Any changes in wind or lean. Is the student aware of these changes?
- Wedging too late or other improper wedging.

IV. SKILL DEMONSTRATIONS

The following tasks will be accomplished with a gasoline powered chain saw equipped with a 20-24" straight guide bar and all required PPE. Student performance will be documented on the Chain Saw Operator Field Evaluation form.

A. Limbing, Brushing and Bucking

The students shall:

- Demonstrate the approved chain saw starting methods.
- Demonstrate the ability to analyze and mitigate overhead and ground hazards associated with limbing, brushing, and bucking.
- Given a standing tree with limbs near the ground in a closed stand of timber, the student will properly size up, clear the work area, and limb the tree to the height of their head.
- Given a brush field the student will properly size up, clear the work area, cut and remove a strip of brush to near ground level six feet wide (1.8m) wide and twenty feet (6.1m) long.
- Given a prepared sound stump (12-18" diameter), the student will execute a horizontal bore cut through the stump that varies no more than 3/8" in width from the point of beginning to exit.
- Given a downed tree on a slope up to 30 percent, the student will properly size up, clear the work area, and limb and buck the tree into lengths suitable for hand removal.

B. Tree Felling

The students shall:

- Demonstrate the ability to determine and prepare a safe felling area, and maintain cutting area control.
- Demonstrate the ability to correctly identify and mitigate overhead and ground hazards associated with tree felling.
- Given a sound tree and/or snag up to 20" DBH in a closed stand of timber on slopes less than 30%, the student will correctly size up the tree, prepare the intended lay and escape routes, and fell the tree(s) within 15 feet of the center of the intended lay measured at the top of the tree.
- Demonstrate the ability to complete a stump analysis of the student's evaluation tree(s).

When students have successfully completed training, the instructor will award a course training certificate.

The employing agency of the student will establish Incident Qualifications (Red Card).

Instructors shall include any restrictions or endorsements on the Chain Saw Operator Field Evaluation form for the Red Card.

The course coordinator will forward copies of the Chain Saw Operator Field Evaluation forms completed for each student to each student's supervisor.

APPENDIX A

BIBLIOGRAPHY

ADDITIONAL INFORMATION FOR SAWYERS

Web Sites

<http://www.osha.gov/SLTC/etools/logging/mainpage.html>

Hosted by OSHA. This site contains links to federal and state occupational safety and health regulations and practices for loggers, and excellent references with graphics to chain saw operation procedures.

http://fsweb.r1.fs.fed.us/forest/sales/hazard_trees/index.html

Hosted by USFS Region 1. This site has great information for hazard tree training and safety.

<http://www.forestapps.com/gol.html>

Hosted by The Game of Logging Incorporated. This site offers an overview of the Game of Logging, a procedural approach to chain saw operation developed in Europe, and used extensively in commercial logging operations in the eastern U.S.

http://www.oregonchain.com/tech/manual_maint.htm

Hosted by Blount International. This site contains the *Oregon* Maintenance and Safety Manual in downloadable .pdf format. This easy to read manual provides essential detailed information on operating and maintaining the chain saw.

<http://www.husqvarna.com>

Hosted by Husqvarna. This site has links to sawing techniques and maintenance procedures.

<http://www.stihlusa.com> Hosted by Stihl.

This site has links to sawing techniques and maintenance procedures.

Web Sites (continued)

<http://www.fs.fed.us/im/directives/fsh/6709.11/?D=A>
The USFS Health and Safety Handook

<http://www.bianifc.org/operations/documents/opsguide/opsguide.html>
BIA Wildland Fire Program Management and Operations Guide

<http://fire.r9.fws.gov/fm/policy/sm.htm>
USFWS Service Manual

<http://www.fire.blm.gov/Standards/redbook.htm>
Hosted by USDI BLM. This site contains the Interagency Standards for Fire and Fire Aviation Operations “Red Book.” Updated annually, this interagency manual defines program requirements for wildland fire operations.

Chain Saw and Crosscut Saw Documents

Oregon Maintenance and Safety Manual. Blount, Inc., Oregon Cutting Systems Division, 4909 SE. International Way, Portland, OR 97222–4679; (or) P.O. Box 22127, Portland, OR 97269–2127.

Falling and Bucking Training Standard and Fallers and Buckers’ Handbook. Workers Compensation Board of British Columbia, Films and Posters Section, P.O. Box 5350, Vancouver, BC V6B5L5.

An Ax to Grind (9923–2833–MTDC). 1999. U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center, Bldg. 1, Fort Missoula, Missoula, MT 59804–7294.

Chain Saw and Crosscut Saw Videos

An Ax to Grind (99–01–MTDC). 1999. U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center, Bldg. 1, Fort Missoula, Missoula, MT 59804–7294.

Be Smart—Be Sharp—Be Safe. Blount, Inc., Oregon Cutting Systems Division, 4909 SE. International Way, Portland, OR 97222–4679; (or) P.O. Box 22127, Portland, OR 97269–2127.

Chain Saw and Crosscut Saw Presentations

Situational Awareness Exercise for Chain Saws and *Situational Awareness Exercise for Crosscut Saws*. 2001. PowerPoint presentations. U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center, Bldg. 1, Fort Missoula, Missoula, MT 59804–7294.

Chain Saw and Crosscut Saw Training Course includes materials for instructors teaching a 16- to 32-hour course for basic to intermediate chain saw and crosscut saw users. The course is designed to provide the technical knowledge and skills employees or volunteers will need to safely use these tools. The instructor's guidebook contains everything in the companion student's guidebook (Tech. Rep. 0167-2815-MTDC), plus special notes for the instructor, a chapter explaining the field proficiency test, and copies of the course certificate and certification cards. The guidebook includes a glossary and chapters on course information and safety requirements, sample job hazard analysis, additional information for sawyers, chain saw use and maintenance, chain saw tasks and techniques, crosscut saw tasks and techniques, and field proficiency.

Copies of this document may be ordered from:

USDA Forest Service, MTDC
Bldg. 1, Fort Missoula
Missoula, MT 59804-7294
Phone: 406–329–3978
Fax: 406–329–3719
E-mail: wo_mtdc_pubs@fs.fed.us

Electronic copies of MTDC's documents are available on the Forest Service's FSWeb Intranet at: <http://fsweb.mtdc.wo.fs.fed.us>

For additional technical information, contact MTDC.

Phone: 406–329–3924
Fax: 406–329–3719

Chain Saw Videos

Chain Maintenance Clinic: Oregon Cutting Systems. Workers Compensation Board of British Columbia, Films and Posters Section, P.O. Box 5350, Vancouver, BC V6B5L5.

Crosscut Saw Documents

Crosscut Saw Manual (7771-2508-MTDC). Revised May 1988. U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center, Bldg. 1, Fort Missoula, Missoula, MT 59804-7294.

Lightly on the Land: The SCA Trail-Building and Maintenance Manual. 1996. Birkby, Robert C. ISBN No. 0-89886-491-7. The Mountaineers, 1992. Seattle, WA. 1996.

Now You're Logging. 1992. Griffiths, Bus. ISBN No. 1-55017-072-4. Harbour Publishing, Madeira Park, BC Canada. 1992.

Handtools for Trail Work. (8823-2601-MTDC). Revised February 1997. U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center, Bldg. 1, Fort Missoula, Missoula, MT 59804-7294.

Northeastern Loggers' Handbook. 1951. Simmons, Fred C., USDA Agricultural Handbook No. 6. U.S. Department of Agriculture, Forest Service, Northeast Forest Experiment Station.

Food and Agriculture Organization of the United Nations, Basic Technology in Forest Operations. 1992. FAO Forestry Paper No. 36. ISBN No. 92-5-101260-1. Rome. 1982.

Saws and Sawmills for Planters and Growers. 1991. Morris, John, ISBN No. 1-871315-11-5. Cranfield Press. Bedford, UK. 1991.

Logging Principles & Practices in the U.S. and Canada. 1934. Brown, Nelson Courtland. John Wiley & Sons, Inc., New York.

Crosscut Saw Documents (continued)

Country Woodcraft. Langsner, Drew. ISBN No. 0-87857-200-7. Rodale Press, Emmaus, PA. 1978.

Crosscut Saw Reflections in the Pacific Northwest. 1998. Deaton, Jim. ISBN No. 0-87770-675-1. Ye Galleon Press. Fairfield, WA.

Crosscut Saw Videos

Handtools for Trail Work (98-04-MTDC). 1998. U.S. Department of Agriculture, Forest Service, Missoula Technology & Development Center, Bldg. 1, Fort Missoula, Missoula, MT 59804-7294.

Crosscut Saw Training Course: Instructor's Guidebook. Tech. Rep. 0167-2816-MTDC. Missoula, MT; U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 82 p.

APPENDIX B

CHAIN SAW FIELD EVALUATION FORM

CHAIN SAW OPERATOR FIELD EVALUATION FORM

Name:	Agency Address:
Date:	
Training Location:	
Phone:	Email:

Previous Certification? Yes _____ No _____ Level _____ Agency/Unit _____ Year _____

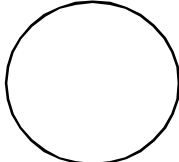
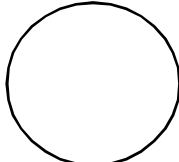
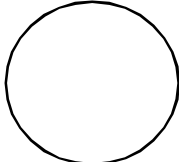
Note to Evaluator: A scale of 1 through 5 will be used to identify proficiency in each area:
 1 = Weak, 2 = Poor, 3 = Satisfactory, 4 = Very Good, 5 = Outstanding.
 0 or N/A means student was not evaluated in area or Not Applicable. All blanks must be filled in.
Any safety violations will result in automatic failure.

YES	NO	SAFETY EQUIPMENT	SCORE	CHAIN SAW USE	SCORE	HAZARD ANALYSIS
		Hard Hat		Chain Saw & Axe Condition		Top
		Eye Protection		Starting Procedure		Widow Makers
		Hearing Protection		Throttle Lock Use		Bark
		Long Sleeved Shirt		Correct Body Position		Leaners
		Gloves		Thumb Placement		Hang-ups
		Boots		Bar Tip Use - general		Determine Soundness & Lean(s)
		Chaps		Boring - specific		Snag/Green Tree Hazards
		Axe (3-5 lb)		Chain Brake Use		Root Wads/Loose Logs
		Wedges (appropriate)		Foot Travel with Chain Saw		Wind
		Approved fuel/oil container		Chain Saw Tool Kit		Spring Poles
				Field Chain Sharpening		Disease/Fungus
		NOTE: Any safety item deficiency will result in automatic failure.		Other (list)		Other (list)

SCORE	NO	LIMBING & BRUSHING	SCORE	NO	BUCKING
		Overhead & Ground Hazard Analysis			Overhead & Ground Hazard Analysis
		Brief Swamper			Escape Route
		Control Cutting Area			Bind / Tension-Compression Analysis
		Swamps Out Work Area			Swamps Out Work Area
		Escape Route			Thumb Placement
		Body Positioning			Use of Wedge / Pie Cut
		Thumb Placement			Cut Sequence
		Use of Bar Tip			Kerf Observation
		Avoids Over / Under Reaching			Release Cut Movement
		Power-head below Shoulder Height			Multiple Bind Situations
		Limb Removal Sequence			Drop Cutting
		Spring Poles-Tension/Compression Analysis			Spring Poles-Tension/Compression Analysis
		Avoids Kickback			Avoids Kickback
					Wedging Procedure

FALLING							
SCORE		FELLING AREA		SCORE		FELLING PROCEDURE	
			Saw Team Safety				Go / No Go Decision / Walk Away
			Maintains cutting area control				Plumb Lean - Determines Lay
			Establishes positive communication				Escape Routes, Alternatives, Safety Zones
SCORE		STUMP ANALYSIS		SCORE		FELLING PROCEDURE	
			Felled to Desired/Other Lay				Undercutting - Gunning or Horizontal Cut
			Gunning Cut Position				Use of Gunning Sites
			Sloping Cut Position				Sloping Cut
			Undercut/Face Cut Angle and Depth				Warning Shout
			Back Cut				Back Cut
			Dutchman - one/both corners				Cuts in upright position / Looks Overhead
			Holding/Hinge Wood				Procedure Alteration (if necessary)
			Undercut as a Whole				Wedging Procedure
							Use of Escape Route / Safe Zone

EVALUATOR'S STUMP ANALYSIS SKETCHES

		
Tree 1	Tree 2	Tree 3
Height _____ DBH _____	Height _____ DBH _____	Height _____ DBH _____
% Slope _____ Species _____	% Slope _____ Species _____	% Slope _____ Species _____
Condition _____	Condition _____	Condition _____
Feet from Center of Lay _____	Feet from Center of Lay _____	Feet from Center of Lay _____

COMMENTS: Attitude, Technical Skills, Verbal Skills, Weak-Strong, etc. (be specific)

RECOMMENDED SKILL LEVEL (circle one): Apprentice (FALA) Intermediate (FALB) Advanced (FALC)

RESTRICTIONS (if any): _____

Course Instruction Given At: _____

Instructor Signature: _____ Title: _____ Level: _____

Recommended By (if applicable): _____ Title: _____ Level: _____

Field Examination given at: _____ Date: _____

Evaluator's Signature: _____ Title: _____ Date: _____

Evaluator's Signature: _____ Title: _____ Date: _____

Student's Signature: _____ Title: _____ Date: _____

Supervisor's Signature: _____ Title: _____ Date: _____