Best Management and Operating Practices for Steep Slope Machine Logging

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Travis Naillon, Safety and Health Specialist

Christina Rappin, Research Investigator

Safety and Health Assessment and Research for Prevention (SHARP) Program
Washington State Department of Labor & Industries
PO Box 44330
Olympia, WA 98504-4330

www.Lni.wa.gov/Safety/Research

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Disclaimer

This report contains best management and operating practices developed from interviews with operators, timber fallers, owners, and manufacturers of steep slope logging machines, and from field observations of steep slope logging.

The best management and operating practices do not create new regulations or new legal obligations. Operators should be aware that current logging regulations apply to steep slope machine logging. Many applicable regulations have been noted in this document. Where current regulations do not apply, these best management practices are recommended.

Discussion of specific products or equipment does not constitute an endorsement of a product's quality or safety.

Washington's experience with the use of steep slope machines is evolving, and these recommendations may be updated periodically.

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List of Abbreviations

DOSH	Division of Occupational Safety and Health
L&I	Washington State Department of Labor and Industries
RPE	Registered Professional Engineer
SHARP	Safety and Health Assessment and Research for Prevention program
SSM	Steep Slope Machine

Glossary of Terms

Base machine
Machine that is stationary and has a winch or winches mounted on it to assist the SSM.

Side Wash
The use of trees, stumps, ground, or other objects to change the direction of the SSM tether line.

Steep Slope Machine (SSM)/Tether Machine
Machine tethered to the base machine and equipped with a cutting head that falls or logs timber on slopes.

Steep Slope Logging/ Tethered Logging
Logging or felling trees on slopes using a winch line for traction assistance of one or more machines on slopes steeper than typical for mechanized logging equipment.

Competent Person

One who is capable of identifying hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous.

Qualified Person

A person, who by possession of a recognized degree, certificate, professional standing, or by extensive knowledge, training, and experience, has successfully demonstrated ability to solve or resolve problems relating to the subject matter, the work, or the project.

1. Introduction

1.1 Steep Slope Machine (SSM) Logging

Safety and production concerns in traditional steep slope logging operations have led to the development of steep slope machine (SSM) logging technology.

Traditional steep slope logging operations involve manual tree falling and cable rigging operations in difficult terrain. Timber fallers and rigging crew members suffer some of the highest rates of severe job-related injury in the United States. Using an SSM reduces risk by eliminating the need for manual ground work.

Traditional steep slope logging is labor-intensive, and the primary cost of production is labor. In situations where an SSM can operate, it can replace six or more people on the ground and modify work practices to improve efficiency and safety. SSM logging improves the efficiency of production by mechanizing processes. Current SSM operations are associated with timber falling, but the use of a grapple yarder with the system is anticipated. If these innovations occur, all ground personnel would be eliminated where the use of SSMs is feasible.

Contract loggers have been working on steep slopes using self-leveling cab equipment. The self-leveling cab redistributes the center of gravity uphill to improve stability for work on slopes over 65 percent (Visser & Stampfer, 2015). Loggers have been trying to improve safety, reduce costs, and increase production on steeper slopes for years and mechanizing the operation has the ability to do that. Between leveling the machine for stability and increasing grouser length for traction, loggers have already been increasing the slope where they can operate.

Steep slope machine logging is the next advancement in mechanizing logging operations. While steep slope machines have been used in Europe since the 1990's (Sebulke, 2011), the technology has only recently been adopted in the US. SSMs can be used for falling trees, yarding (the movement of logs from the place they are felled to a landing), or both. Although there are variations of the system, an SSM is typically attached by one or more wire ropes to an anchor, either a base machine or stump. The technology works by winching the SSM to the anchor, providing traction assistance for the SSM. The traction assistance allows steeper slopes to be harvested by machine rather than harvested manually.

Some steep slope machines use an internal wire rope winch and anchor to a fixed object (Photo 1). In other systems, the SSM is connected to a stationary base machine that has one or two winches to assist the tracked machine on steep slopes (Photos 2 & 3). The operator controls the winch or winches for traction assistance while ascending and descending slopes. Multiple variations of these systems are currently being used in

Photo 1. Internal Drum

The ClimbMAX system has a single wire rope with an internal drum. The wire rope is anchored directly to a tree, stump, or another fixed structure.

Photo 2. Dual Line

Tractionline is a dual wire rope auto-tension system. The two drums are mounted on a base machine that is positioned uphill and communicates with the tether machine via radio signal.

Photo 3. Single Line

Summit is a single wire rope system. The drum is mounted on a base machine positioned uphill of the SSM.

Washington State. They all perform the same basic function of allowing mechanical harvesting to take place on steeper slopes than has previously been possible.

There is a common misconception that steep slope machines are suspended and may fall or slide uncontrollably without the winch rope holding them in position. The winch rope is designed for traction assistance and does not hold the machine on the hillside (Evanson, et.al, 2013). On most SSMs, the winches function automatically during normal operations and are not under the control of the operator (MacDonald, 2016). The winches let line in or out as the operator moves the machine as they would in normal operations. Most equipment roll overs are caused by an initial loss of traction resulting in an uncontrolled gain in momentum (Visser & Stampfer, 2015). In SSM equipment, the wire rope assists so that the loss of traction does not occur. Brief studies in Australia and New Zealand indicate that the actual tensions do exceed expected tensions on SSM when traveling (Visser & Stampfer, 2015).

1.2 Impacts of SSM Harvesting

Much as with the advent of mechanized log processing and timber falling, the mechanization of falling timber and logging on steep slopes has the potential to increase safety and production, but may also introduce new hazards. When processors were introduced into normal logging operations, workers were no longer required on each job to hand limb and buck logs. This also sped up manufacturing, decreased the number of employees on the ground, and landings could be smaller without the need for people to work on the ground bucking logs. Similar industry changes occurred with

mechanized falling: one machine replaced three or four people on the job; production increased; hazards decreased; trees could be bunched for quicker yarding; and the way that harvesting is done changed. The adoption of SSM logging will also potentially have economic, safety, and other impacts on the logging industry in Washington State.

1.2.1 Economic Impacts

Employment

There will likely be an overall reduction in the timber workforce with the widespread implementation of steep slope machine logging technology. When SSM technology is used, one machine and one operator can take the place of two to three hand fallers and four to seven people working on a yarding crew.

The main impact will be on timber fallers. While timber fallers will still be required to fall large timber and timber in areas that cannot be felled by SSMs, such as steep draws and rock outcroppings, a significant portion of timber falling on steep slopes can be machine logged with the new technology.

Some employers adopting this technology had struggled to hire timber fallers and rigging crews, but found it easier to hire equipment operators. Operators receive a higher wage than rigging personnel and timber fallers would, and work more consistently throughout the year, making it a more sought-after position.

Capital Costs

Capital investment in SSM systems prohibits adoption of this technology by many firms. Typical SSMs observed in the field have a price tag of over one million dollars (US). Currently, it remains more expensive to cut using an SSM than manually falling, primarily due to the increased production of manual falling and low overhead. In addition, there is the cost of training a new SSM operator (estimated at two months for an experienced machine operator), and the potential purchase of a second processor to keep up with the increased yarding of bunched timber piles. The economic impact will not be distributed evenly. Those firms that integrate SSM falling (less productive) with yarding operations (more productive) within their firm will likely yield a greater economic benefit.

Production and Utilization

While it is currently accepted that hand falling may be more productive on an hourly basis, SSM logging is thought to increase overall production and utilization of trees. SSM logging can be done during poor weather conditions. Timber fallers and rigging crews may not be able to operate in windy conditions that create a hazard, but it does not impact mechanized falling as severely.

The utilization of timber is increased because the machines have better control of the timber as it is falling causing less breakage in each tree. One contractor noted utilization up by 20 percent. Another contractor is now bidding jobs that would have required downhill wire rope logging that they would not do, but with their SSM it can be felled and logged downhill with one person and one machine.

In manual falling operations, trees cannot be piled into bunches. By placing them in bunches, or incorporating a grapple yarder, productivity in the amount of volume per cycle increases dramatically. One New Zealand study found that the yarding volume for hand felled trees was 24.4 trees per hour, and in bunched piles was 40.0 trees per hour, and averaged about a 33 percent increase in production (Amishev & Evanson, 2010). When tower logging non-bunched trees, the processor is often inefficient due to the lower volume of timber being brought to the landing. When bunched, the volume of timber on the landing is much greater, and often the processor is unable to keep up.

In informal interviews, Washington logging contractors reported that yarding bunched piles increases production by 15 – 20 percent. This production increase will likely require larger landings to accommodate a second processor and an increase in the volume of logs on the landing at any one time. Overall, this may reduce the need for the number of towers currently working on industrial timberlands.

1.2.2 Safety and Other Impacts

Increased hazards for timber fallers

Until the advent of steep slope machines, mechanical falling was limited to flatter ground. While SSM logging technology allows for falling timber mechanically on steeper terrain, it also leaves timber that cannot be felled by SSM. Hand fallers will now be exposed to terrain that cannot be mechanically felled due to steepness, rocky ground, standing beyond the reach of an SSM system or other issues. The steep draws that cannot be mechanically felled are often filled with heavy leaning alder, and requires fallers to be walking continuously on steep terrain falling small areas. The SSMs typically have between 1,200 and 1,500 feet of winch wire rope, so anything further than that from the base machine has to be hand felled. Adding extensions to the end of winch wire ropes is being considered by some operators to increase the distance in which SSM can operate from the base machine.

Planning how the harvest unit will be cut and logged can reduce hazards to fallers. If the hand cutting is performed after the SSM logging, new hazards may be created. If the operator does not place the cut trees in the correct location, trees left for hand fallers will be “brushed in.” This creates a situation where timber fallers may not have an escape route, causes difficulties walking in the work area, and can create hazards of working below felled timber. There may also be more dislodged limbs in the standing

timber because standing timber left for the hand fallers to cut is struck by trees felled by SSM. This is more likely when a grapple saw is used because they have limited control of the tree being felled.

Increased hazards for rigging crew members

The rigging crew may also be exposed to some new hazards. In some ground conditions, SSMs create ruts that the rigging crew has to walk through.

Another hazard is an increased amount of chunks on the hillside that could roll back down the hill when the crew is working. Chunks are created when machines have to cut stumps low enough to travel over. The chunks are usually produced by hot saws, but they are also created by grapple saws. During logging operations these chunks can become dislodged and roll down the hill.

Reduced hazards from SSM logging

Using steep slope logging machines reduces the number of workers doing the two most hazardous jobs in the logging industry: timber falling and setting chokers. Manual logging has been a focal point of safety concerns for many years and the advent of SSMs will reduce the need for these high hazard jobs. Using SSMs presents a safer alternative to falling hazard trees on steep slopes and along fire lines.

Steep slope machines can directionally fall and pile timber. This makes it easier for choker setters to find logs and get better ends on the logs to set the choker. Having better ends decreases the chance of logs upending and keeps all ends the same length when the turn reaches the landing.

SSM logging also leads to less cluttered ground for the rigging crew, which has the potential to decrease the numbers of slips, trips and falls. It also allows for quicker and easier paths to get in the clear.

Communication between landowners and loggers to plan the cutting and logging of each unit has increased with the use of an SSM. The logging and cutting plan have to be organized together. The unit is more thoroughly evaluated so that landing locations are appropriately selected to use the correct equipment for each part of the unit. Organized approaches to harvest operations, to keep the different types of operations safe distances from one another, and to schedule different operations increase with the use of SSM logging.

1.3 Development of the Best Management and Operating Practices

Steep slope machines are now falling a significant portion of timber in Washington State. These initial best management and operating practices were developed to address the rapid adoption of this technology and the relative absence of safety

experience with these systems. These practices evolved from interviews with contract loggers and landowners, observations of several different types of SSM systems, analysis of near-miss and accident investigations, review of existing guidelines from the international logging community, and the applied safety experience of the author.

Some initial areas of concern regarding emerging SSM technology and procedures include:

- Economic impacts to fallers and rigging crews
- Safe distances between felling machines and other machines
- Use of equipment placed below SSM operations
- Recommended safety devices
- Approaches to securing the base machine
- Need for training on wire ropes, shackles, and anchors
- How to inspect the wire ropes and equipment
- Safety practices for side wash
- Side pull on shackles
- Need for operator comfort
- Maintaining an effective radio signal
- Sign placement and verbiage for safe operations in the field
- Training

These initial best management and operating practices are a starting place for safety regarding SSM systems. The information provided in this document does not create any new legal or regulatory requirements. It is designed to be used as a safety guide, and will be updated periodically as technology and practices advance. The information in this document was created in collaboration with the Washington State Department of Labor & Industries, operators, manufacturers, company owners, and landowners.

2. Best Management and Operating Practices

2.1 General Planning

See Appendix E for a guide to pre-job planning prior to harvest.

Ample time will be needed to plan for the setup of the SSM, as well as any other operations that may be happening concurrently.

- Walk the area to be logged and identify hazards, areas that can be harvested using an SSM, and locations of the landings. Consider how the area will be harvested.
- Plan:
  - Which areas are to be harvested with an SSM.
  - Placement of the base machine, or which stumps might be used for anchors.
  - In general how the job will be completed, including:
    - Haul routes
    - Areas to be hand felled
    - Landings
    - Identifying ground based and cable logging areas
  - Order of operations.
  - Communication with all affected personnel.
  - Signs needed and roads to be blocked.
- If operators will be working before daylight hours, preplan work. Hazards of SSM logging in the dark include:
  - Operators may not be able to see if side washes are in the line (not straight).
  - Hazards such as rock, soft spots, and terrain changes may not be visible.
  - If equipment breaks down, the operator will have to walk out in the dark.
- Mark on the ground or on a map the areas to be hand felled. Consider the safest option for hand fallers, which may be falling prior to the SSM. These plans may change due to weather conditions, soil conditions, or other unforeseen issues. If plans change, communicate this with all affected personnel.
  - Winter conditions can create safety hazards for standing timber not cut by SSM, such as blowdown or broken tops. If this is likely to happen, it is important to plan to let the hand fallers work first.
- Prioritize reducing hazards for ground workers by planning how to clear trails for fallers and the rigging crew, avoid brushing trees, and stabilize loose materials.
- Create an emergency medical plan.
- Develop emergency procedures for retrieving the operator.

- Consider operator fatigue when setting work hours.

2.2 Working with Manual Timber Fallers

- Communicate the harvest plan with the hand fallers, and involve them in the planning processes.
- Flag or map out the area to be hand felled.
- Have the hand fallers work first if possible. Hand fallers have the highest risk job and their safety needs to be the first priority.
- If fallers are working after an SSM completes its felling, do not fall trees into standing timber, do not brush standing timber, and ensure all piles are stable on the hillside if fallers will be working or walking below felled timber.
- Plan specifically for each unit, and update the plan as needed, for example, when weather and ground conditions change.
- The sequence of felling varies by unit. Walk and plan each unit.

2.3 Check in Procedures

- Have a method in place to monitor when the machine operator is working, including arrival and departure check-ins.
    - Periodic check-ins with machine operators should be conducted at least once every two hours during the work shift when machines are operating on slopes over 80%.
    - If other personnel are onsite, check-ins can be done with cell phone, two-way radio, or other forms of communications.
- The operator should have a designated contact person when getting out of the cab. The contact person can either be on or off site. The operator should provide a description of the work activities they will be conducting outside of the machine, and an estimate of completion time. After returning to the cab, the operator should contact the designated person.

2.4 Emergency Procedures

- Develop an Emergency Medical Plan, which includes:
    - Township, range, and section, latitude and longitude, or UMS grid system coordinates.
    - Direction by road or escort provision to site.
    - Phone number for emergency medical services.
    - Provision if working behind a locked gate.

    - How to get an operator safely to a road in the event of an emergency.
- Leave a copy of emergency medical plan in the base machine in case someone other than operator needs to call in.
- If timber fallers will be working after the SSM, maintain a clear walking path to extract fallers in case of injury.

2.5 Personal Protective Equipment

- Footwear:
    - Wear boots that support the ankle at all times.
    - Wear cut-resistant boots if notching stumps or bucking logs.
    - Wear caulk boots when walking on logs.
- Wear gloves when handling wire rope.
- Keep a hard hat in the machine so it is available if the operator needs to leave the cab. Ensure that the operator wears a hard hat when outside of the machine.
- Wear high-visibility outer garments when working outside of the cab of the machine.
- Wear chaps if operating a chainsaw.
- Use eye protection if operating a chainsaw.
- Use hearing protection when indicated.

2.6 Steep Slope Machine (SSM)

2.6.1 SSM Design Recommendations

General

- Use an SSM that is designed or modified by the manufacturer or an RPE specifically for tethered logging.
- Hitches used for tethered logging should be installed according to the manufacturer or an RPE's specifications by a certified welder.
- Add a minimum of 2-inch grousers to increase the traction and limit the amount of tension placed on the tether line(s).
- Add a section of chain between the SSM hitch and the wire rope(s) to decrease the likelihood of unintentionally cutting the line.
- Have an overriding braking system in the event of machine power loss.

- An audible notification or alarm should activate when the signal between the machine and winches is weak, prior to being lost.
- Have a clinometer that continuously measures slope.

Wire Rope and Connectors

- Have a reliable method in the SSM to monitor how much wire rope is remaining on the winch drum(s).
  - An automatic stop, or audible and visual alarm, should be activated when the wire rope is at no less than five wraps on the drum.
- Wire rope, sheaves, end connections, blocks, and all rigging must meet current WACs:
  - Wire Rope WAC 296-54-557.
  - Wire rope splicing WAC 296-54-55720.
  - Rigging inspection 296-54-54710 and manufacturer recommendations.
  - Shackles 296-54-54730.
  - Rigging straps 296-54-54740.
  - Rigging blocks 296-54-54750.
  - Wire rope attaching and fastenings 296-54-55730.
- The SSM should have a preset maximum wire rope pull that does not exceed 33% of wire rope and breaking load.

SSM Cab

- Ensure that the SSM cab is in compliance with WAC 269-54-57355 (ROPS/FOPS/Forestry Cab).
- The secondary escape is able to open from the outside.
- Provide a harness with a minimum of 4-points. Add padding to the shoulder of the harness.
- All safety monitors should be positioned in the operator's line of sight.
- To minimize operator neck strain, install a camera that provides a view up the tree.

2.6.2 SSM Operating Recommendations

- Conduct a steep slope hazard assessment before operating. (See *Appendix D: Steep Slope Hazard Assessment and Identification*)
- Inspect the SSM each day prior to starting operations.
- Check that all communications systems with other workers on the unit are functioning prior to operating.

- Know and follow all manufacturer's recommendations, including the maximum angle of pull off the sheave.
- When there is a loss of line tension, either intentional or unintentional, walk the SSM away from the base machine to take up the slack, if conditions are safe to do so.
    - There is an increased risk of spooling issues and line damage with a loss of tension. Stop and complete a system inspection after an unintentional loss of tension.

Photo 4. Logs placed to keep lines from rubbing against rocks on road.

- Operate only on auto-mode unless:
    - The wire rope(s) must be slacked to move over obstacles.
    - There is a need for the wire rope(s) to be slacked to maneuver towards the base machine.
    - There is need during an emergency situation.

  As soon as machine is operating again, place back in auto-mode and hit travel pedals.
- After an emergency situation, complete a full system inspection before resuming operations.
- Fill in any holes in the terrain that could cause the SSM to rock side to side.
- Ensure that the edge of the landing does not impact the stability or integrity of the wire rope(s). Place a log on the edge of the landing to keep the wire rope(s) free of soft dirt and rocks.
- If the wire rope(s) go over rocks, place cribbing between the wire rope(s) and rocks to avoid damage (photo 4).
- Operate only with door(s) closed.
- Place tools, spare chains, hoses, and other equipment on the machine so that they are easily accessed by the operator and do not create a hazard.
- Have a time-based maintenance plan in place.

2.7 Base Machine

2.7.1 Base Machine Design Recommendations

Ensure that the base machine for the SSM:

- Is capable of receiving live tension status in SSM.

- Is designed with an automatic stopping system in case of mechanical failure or excessive machine movement.
- Is able to indicate how much wire rope is left on each winch drum.
- Has an effective automatic stop, or audible and visual warning, that engages when the wire rope reaches no less than five wraps on the drum.
- Has a warning device in place for when the communication signal between the base machine and SSM becomes weak and before the signal is lost.

2.7.2 Base Machine Operating Recommendations

- Inspect the base machine:
  - Each day prior to starting operations.
  - After the machine is moved.
  - When there is a concern about damage.
- After every base machine shift, briefly inspect: drums for proper spooling, termination points, chains, and shackles.
- Follow manufacturer's recommendations for operation and maintenance.
- When a base machine is operating on a roadway, block the road, or at a minimum place signs warning of a remote operated machine or active cutting. Use flaggers when needed.
- Ensure that the wire rope(s) is secured and not able to be pinched or crushed during moves on and off lowboys.
- If the machine is required to use a chain or guy wire rope, use it.
- Keep machine as level as possible (unless it is to be tilted back for more weight).
- Ground and stabilize all components/attachments, such as buckets, blades.
- If using an excavator-type machine, dig bucket into ground whenever possible.
  - If another means of equal securement is unavailable, place a log under the front track, move the back track into a ditch, or find another method of keeping more weight on the back of the machine.
- The bucket should be in line with SSM machine as much as possible.
- In excavator based machines, extend the boom at least 90 degrees.
- If using a dozer-type machine, have the blade down with a sufficient amount of material pushed up in front of it to prevent movement.
- If a suitable stump is available, place the blade or bucket against the stump for added support.

- Avoid having the machine sit on the soft edge or shoulder of the road.
- Maintain and use at all times devices that sense the movement of the anchors. There should be an audible alarm in the SSM.
  - When sensors on the base machine detect movement, immediately stop operation of the SSM until the base machine is inspected.
  - Place movement sensors where they will be most effective.
- If communication between the machines becomes weak or is lost, discontinue work and move back to where there is a strong communication signal.
- To avoid damage to the wire rope(s) and end connections, when moving the base machine:
  - Keep wire rope tensions as low as possible.
  - Do not run end connections through the sheave.
- Do not allow people to sit in the base machine. Exceptions include:
  - Training purposes
  - Repositioning the base machine
  - Troubleshooting and maintenance
  - Emergency recovery

  The operator should not be in the base machine once normal operating begins.
- Wear seat belts at all times in the base machine.
- Do not allow persons on the ground next to the base machine on the landing or below the base machine on the slope during SSM operation. The base machine could experience sudden unexpected movement.
- If holes, ruts, or other hazards are created on the roadway by the base machine, ensure that the hazards are abated prior to moving out. This includes smoothing out ruts, filling and packing in holes, and cleaning up any trees or limbs that may have fallen on the road.

2.8 Felling with a Steep Slope Machine

- Do not operate the SSM on a side slope. Keep tracks facing downhill. For non-auto tension tethering systems, winch in wire rope slack before operating.
- Ensure that operators know how the tethering system functions, and how important wire rope tension is to the safety of the operation. Poor understanding of wire rope tension can increase safety hazards.
- If the SSM is bouncing more than normal, increase tension on wire ropes.
- Limit the time that the cutting disc is positioned over the wire rope or chain.

- Turn off the cutting disc when walking the SSM uphill when not actively cutting.
- Try to plan the lay and how trees will be felled at least four trees in advance.
- Only experienced operators can fall oversize trees with an SSM (i.e. trees that require multiple cuts due to diameter); otherwise, trees should be felled by hand.
- Hand fall trees too large to safely fell with the SSM.
- If a tree must be left with a partial cut, mark the area and warn affected personnel.
- Fall trees into the open whenever possible. This will keep ground visibility better for areas not yet operated, decrease overhead hazards when out of the cab, and create fewer hazards for the next phase.
- If bunching for a yarder, size each pile to fit one choker (2-4 logs). If possible, set piles so there is a spot to get a choker under them with good ends.
- Keep slash, downed logs, and other debris clear of the front of the machine to increase ground visibility and minimize traction loss.
- Pile brush in an area that will not impact the rigging crew or hand fallers. If possible, create walking paths for ground crews.

2.9 Logging with SSM Systems

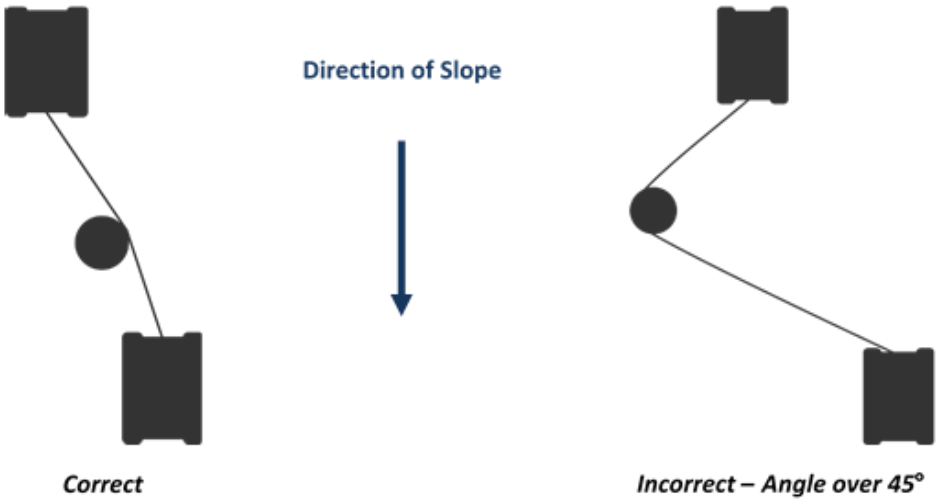
- Orient trees with butts facing downhill for better control of the logs when logging downhill.
- Never work below unstable tree piles.
- Notify all affected personnel if there is a chance that logs or other debris could roll or slide downhill or block a road.
- Do not use a second machine downhill of an SSM if there is a potential for trees or debris to roll or slide downhill.

2.10 Wire Rope Side Wash

Side washing is used to bend the tether line(s) around an object for redirection.

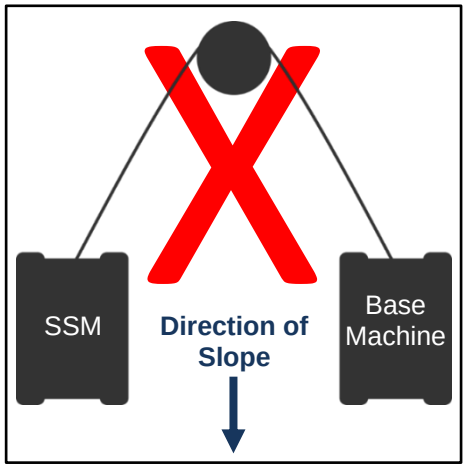
- Hazards or concerns associated with side washing tether lines include:
  - Inaccurate line tension readings, which may lead to system overloading.
  - Pulling the tree or stump over.
  - Line sliding off tree or stump.
- Side wash the wire ropes as a last resort. When possible, move into lead with the line(s), or relocate/change the base machine/anchor to avoid wire rope side wash.

Figure 1. Wire rope side wash.



- When using a stump or tree to side wash wire rope, the angle should be less than 45 degrees, unless the operator is experienced and trained in these procedures.
- Only allow experienced operators to side wash after being trained on how to choose stumps or trees, hazards associated with side wash, and limitations of the system.
- Recognize that stumps that have been damaged by equipment will likely have weakened root structures.
- Stump size, species, and ground conditions are important factors in wire rope side wash. If the soil is rocky or wet, the roots systems will not be as strong. Certain species of trees have better root systems than others. Ensure that:
  - The stump is tall enough so the wire rope will not slide off.
  - The stump is able to support the pressure that will be applied.
  - There is a second stump or tree in close proximity that the wire rope will catch if the stump or tree pulls. If using a two wire rope machine, have each wire rope side wash over a separate stump
- When using a stump to side wash and cut a downhill piece, use a block (figure 2).
- Keep standing timber in the bight.
- Keep the tracks of the machine as parallel to the hill slope as possible.
- Intentional side washing more than once per line is not recommended.

Figure 2. Use a block with side wash for downhill cutting.



2.11 Machine and Equipment Inspection

See Appendix F for a Daily Inspection Guide

- Inspect:
  - All end connections and shackles a minimum of once per day, or anytime they may have sustained possible damage.
  - Visible portions of wire ropes daily.
  - Wire rope as recommended by the tethering system manufacturer, and monthly at a minimum.
  - Wire ropes if you see moss or debris staying on them. This is a simple indicator that there are likely broken wires.
  - Wire rope anytime there is reason to believe damage has occurred.
  - All rigging and each machine prior to each use.
- The SSM counterbalance may rub on the wire rope(s) or chain(s) and may cause quicker wear at those points. Inspect these areas more frequently.
- Maximize use of daylight hours for equipment inspections.
  - Inspect the machine at the end of the shift if starting prior to daylight hours.

2.12 Repairs

- Follow Lockout/Tagout (LOTO) procedures for all machine service and maintenance activities in accordance with WAC 296-54-517.
- Spliced eyes must be three tuck and meet Wire Rope Splicing Regulations (WAC 296-54-55720(5)).
- When on the SSM and performing maintenance (most commonly replacing the chain or a blown hose) do the following:
  - Park on the most level area.
  - Use machine to clear a safe working spot on the ground.
  - Make sure the machine is stable.
  - Ensure trees and other debris on the uphill side of the machine are stable.
  - Have all attachments and moving parts grounded, stabilized, and off, e.g. boom, cutting head, blades, etc.
  - Engage the parking brake.
  - If machine is out of service or not operable, winch the machine to the landing for repairs.
  - Have door positioned so that there is easy to access the steps.
  - Maintain three points of contact when on the machine.
  - Be careful not to step on slick limbs or logs.
  - Check for overhead hazards.

- Do not attempt repairs if weather or site conditions make it hazardous. Examples; high winds, snow or ice, too steep of terrain, or dark. In those situations, attempt to get machine to a safe location if possible for repairs, or wait for a change in conditions.
- Keeps tools and spare parts accessible and store them in a manner that they do not create hazards.
- Keep a spare antenna in the SSM.

2.13 Training

See Appendix A for sample training guide for SSM equipment operators

- Follow the manufacturer's recommendations for SSM operation.
- Have new operators work under direct supervision until a competent person deems them qualified to operate the SSM.
- Provide and document hazard awareness training for all employees working on or around SSM systems.
- Include in training content:
  - SSM and base machine operation
  - Machine(s) and rigging inspection
  - Hazard identification
  - Anchor set up and inspection
  - Machine stability
  - When and how to use side washing
  - How to set up base machine
  - Follow operator's manual
  - Lockout/Tagout procedures
  - Communication: Check in/on procedures, communicating with hand fallers or other affected persons, and communication with operators when roads are closed
  - Safe felling and logging procedures
  - Soil composition
  - How all safety systems operate in emergency situations
  - The working load limits of the machinery
  - Tether system specifications, operations, and limitations
- Conduct and document monthly safety observations for each operator. Communicate the results with the operator and retrain as necessary.
- Operators should be in good enough physical health to be able to walk up steep slopes and out of the work area in the event that a machine breaks down.

3. Equipment Best Practices

3.1 Wire Rope

See WAC 296-54-557

Figure 3. Strand and Lay of Wire Rope

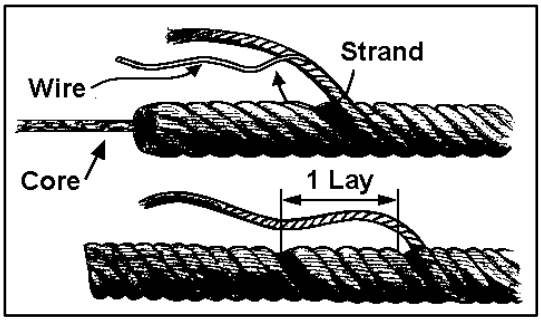


Image found in WAC 296-54-557

- Add a section of chain between the SSM hitch and the wire rope:
  - To reduce wear when pulling trees across wire rope.
  - To reduce the likelihood of cutting through a tether line with a bunching head.
- Do not use knots for connections.
- Do not use quick knobs as a means of end connection.
- Ensure that wire rope inspections, splicing, and anchoring are done by a competent person. If the operator will be doing wire rope inspection, ensure that they have been trained by a competent person.
- Inspect the visible portions of the wire rope:
  - Before each use.
  - Anytime there is reason to believe that damage may have occurred. For example, when lines have bitten into stumps, rubbed over rock, been run over by tracks, or been pinched, or when there is an unintentional loss of tension.
- Use wire rope of the same grade or better than recommended by manufacturer of the tethered logging system.
- If using extensions, ensure that they are:
  - Equal in breaking strength to wire rope being used.
  - Attached with a flush pin or straight side shackle connecting the eyes.
- Develop a policy for when to replace lines and “upend” lines. Criteria could be based on the number of hours in use or a specific timeframe. For example, reverse the line ends at 1,000 hours worked or every six months, and replace the line at 2,000 hours worked or at one year.
  - This will not replace the required inspections and out of service criteria.
  - Keep a log of the in-service date for lines and end connections.

Out of Service criteria:

- Six randomly distributed broken wires in one lay.
- Three broken wires in one strand in one lay.

- Evidence of any heat damage.
- Corroded, damaged, or improperly applied end connections.

3.2 Chains

See WAC 296-54-29413

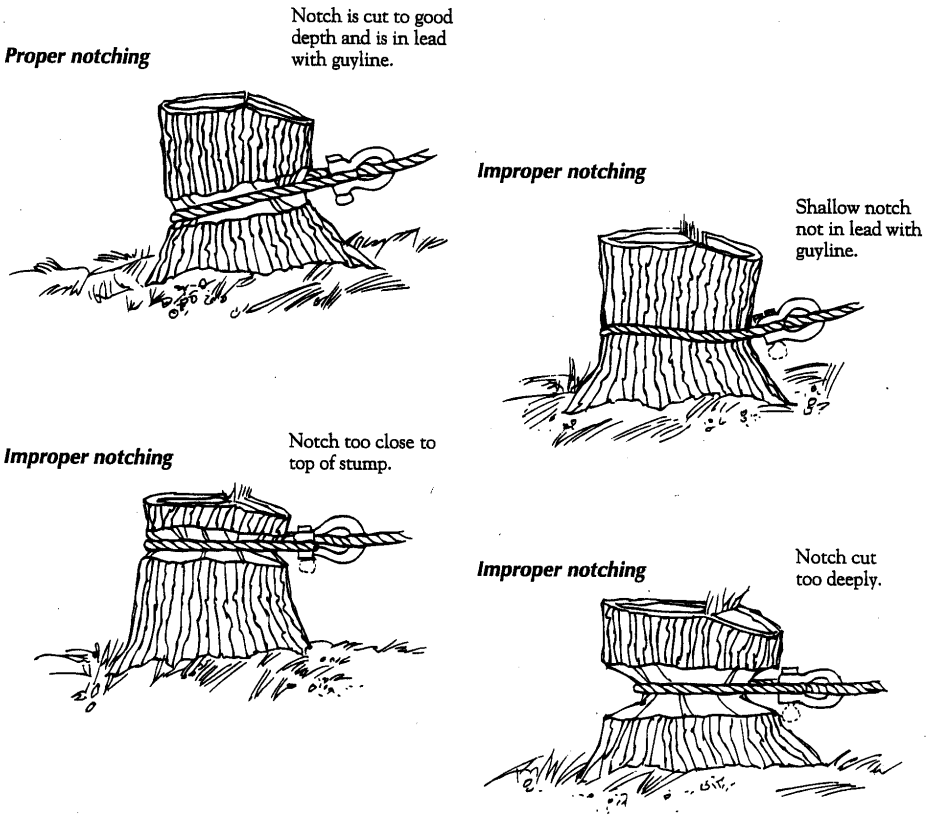
- Measure and document the length of chain at time of purchase. Check weekly thereafter and compare with the original measurement to see if the chain has stretched.
- Do not splice broken chains by inserting a bolt between two links with the heads of the bolt and the nut sustaining the load, or pass one link through another and insert a bolt or nail to hold it (WAC 296-24-29413 (3)).

3.3 Anchors

See WAC 296-54-569

- Notch all stumps.
- When notching stumps, wear all PPE (i.e., hardhat, safety glasses, chaps, ear protection, appropriate footwear, and gloves).
- If needed, tie back stumps.
  - Inspect stump at the start of each shift and anytime a hard pull or increased tension was placed on the stump.
  - Carefully choose stumps for position, height, and strength. When necessary, tie back stump anchors to distribute the load.
  - Each species of tree has a different root system and grows differently according to the soil moisture, density, and slope. The holding power of a stump increases with soil depth and density. Never assume the stumps in one setting will be the same as stumps in the next setting.
  - Stumps are generally strongest with a side pull rather than an upward pull. On slopes, stumps have more root structure on the downhill side, and are therefore stronger on an uphill, rather than downhill, pull. Stumps on the backside of a ridge, with an upward pull, are stronger.
- If using a tree:
  - Attach strap directly to base of the tree.
  - Ensure the tree is solid, has sound roots, and would be a suitable anchor if felled.
- Deadman anchors can be used if properly installed.
  - Do not directly attach wire ropes to the deadman.

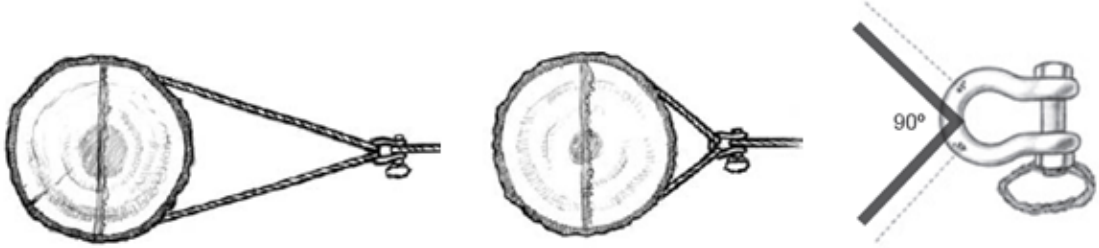
Figure 4. Correct Anchor Notching



Images: OR OSHA

Figure 5. Correct Strap Angle

- **After a strap is passed around an anchor and the two eyes are contained in the "U" part of the shackle, the angle created by the strap eyes must not be greater than 90 degrees.**



Correct *Incorrect — strap is too short*

Images: WA Logger Safety Initiative (LSI) Sample Accident Prevention Program for Logging Operations

3.4 Shackles

See WAC 296-54-54730

Photo 5. Side pull indication marks

Photo: The Crosby Group

- Do not use quick knobs as a means of end connection.
- Use flush pin, straight-sided shackles for mainline, slackline, and skyline extensions.
- Shackles with screw pins, knockout or slip pins may be used to anchor skyline, slackline, guyline, and/or guyline extensions.
- If shackles are in contact with the ground, stumps, logs, or debris, they must be a screw pin type (roll over shackle).
- All other shackles must be screw pin type or have the pin secured with a nut and cotter key, or a nut and molle, except as specified elsewhere and used for specific purposes.
- All shackles must be one size larger than the wire ropes they connect and made of forged steel or material of equivalent strength.
- Shackles used to join wire ropes must be hung with the pin and with the “U” part of the shackle through the eyes of the wire ropes.
- The opening between the jaws of shackles used to hang blocks, jacks, and rigging and to join or attach wire ropes, must be a maximum of one inch greater than the size of the rope, swivel, or shackle to which it is attached.
- Do not allow line to pull past side pull indication marks (photo 5).

Out of service criteria:

Figure 6. Areas of Shackle Wear

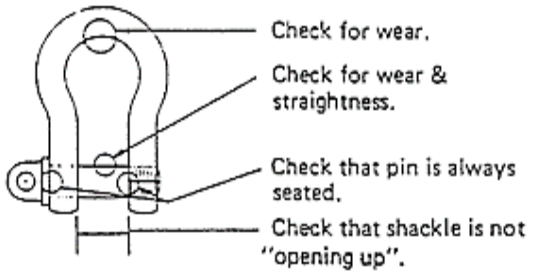


Image: The Crosby Group

- Heat damage, including weld splatter.
- Excessive pitting.
- Excessive nicks or gouges.
- Shackle is bent, twisted, elongated, or cracked.
- 10% reduction in original size at any point.
- Incomplete pin engagement.

Photo 6. Socket was taken out of service due to greater than 10% wear.

Photo 7. Pitting on socket is an indicator or broken wires

3.5 Poured Sockets

- Replace poured sockets when worn. Current testing suggests that sockets should be replaced at 500 hours. The amount of time may be more or less depending on wear.
- Thoroughly inspect the socket before each use, and especially after moving the base machine or after unloading the base machine from a lowboy.
- Pitting is an indicator of broken wires inside the socket.
- Inspect for loose strands going into socket.
- When pouring new sockets, do not reuse bad sockets. Drill out sockets that are not perfectly round to get a good pour.
- Only use manufacturer approved resin.
- Follow manufacturer's 'out of service criteria' for wear.

3.6 Straps

See WAC 296-54-54740

- Straps or chokers used to hang or support blocks, jacks, tree shoes, or rigging must be replaced when there is evidence of damaged or broken wires. The replacement must:
  - Be made of new wire rope; or
  - Meet the pull test strength of new wire rope.
- Synthetic straps must be used according to manufacturer's recommendations.
- Synthetic straps should be used only at a flat or downward angle unless wrapped one full turn around the tree support to prevent the strap from riding up on the support.

- Synthetic straps must be removed from service when wear reaches the limits prescribed by the manufacturer or when deterioration is evident.
- Straps or chokers used to hang corner or tail blocks and straps used to anchor skyline/slackline must be the size required by Table 1.

Table 1. Strap/choker size in inches.

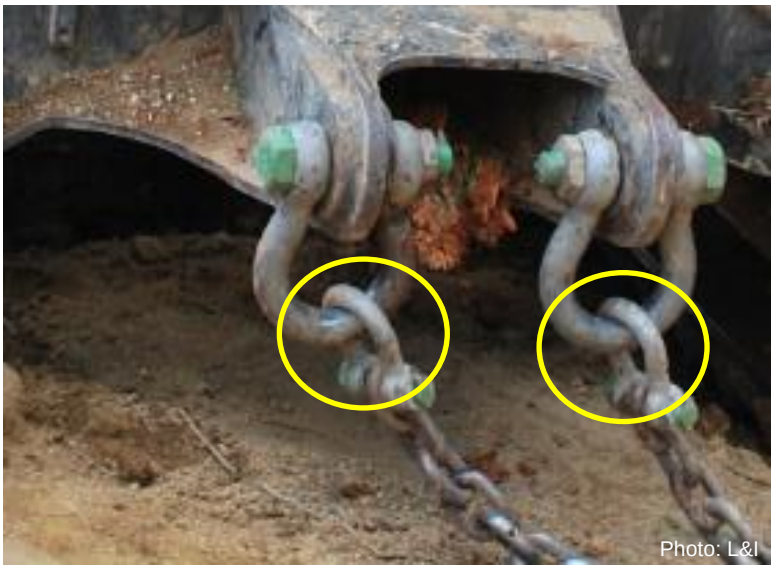
Running Line Size in Inches	Block or Skyline / Slackline Hung in Both Eyes	Block Hung in Single Eye
5/16	1/4	1/2
3/8	3/8	9/16
7/16	7/16	5/8
½	1/2	¾
9/16	9/16	7/8
5/8	5/8	1
¾	3/4	1 1/8
7/8	7/8	1 ¼
1	1	1 3/8
1 1/8	1	
1 ¼	1	
1 3/8	1	
1 ½	1 1/8	
1 5/8	1 1/4	
1 ¾	1 1/4	
1 7/8	1 3/8	
2	1 3/8	

Image found in WAC 296-54-54740

4. High Wear Components

The items in this section have been noted to wear quickly or are more likely to become damaged during use and should be inspected frequently.

4.1 Shackles

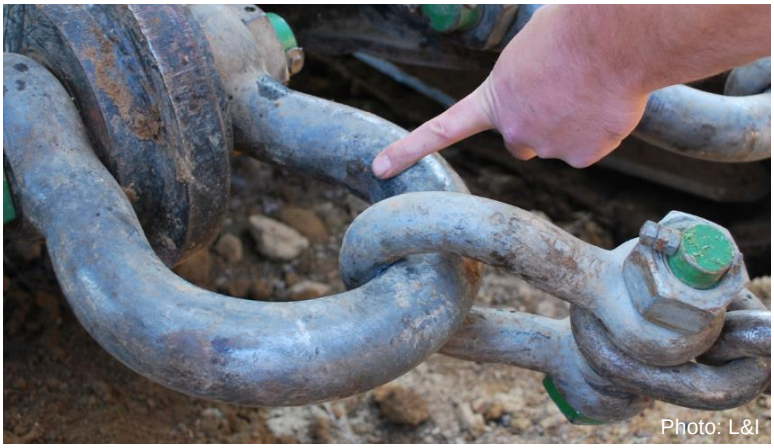


Connection points of the chain to the tether machine

The inside of the smaller shackles tend to have more wear and need inspected daily.

Pin

Look for wear at areas constantly in contact and decrease the pin diameter over time.



Sides

Side pull of the connected wire rope or chain can cause the shackle to “open up”.

4.2 Poured Sockets

1. Connection to shackle

Check for excessive wear at the connection.

2. Wire entry

Check for broken wires, knob pulling out. Pitting is an indicator of broken internal wires and a new pour is needed.

Inspect both areas daily and at each move or relocation of the tether machine.

4.3 Hitches

Corners and welds

Check for spreading at hitch assembly.

4.4 Chains

Area that rubs against counter balance

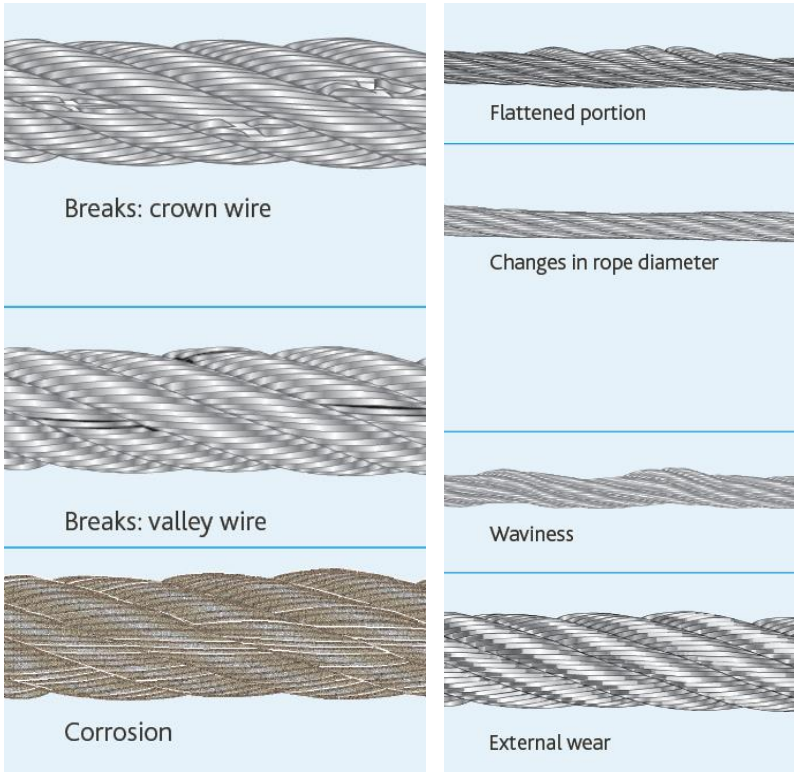
Approximately 5–7 links out.

Bearing Surfaces

Check links and components for:

- Stretching.
- Bending, twisting, or deformation.
- Evidence of heat damage.
- Excessive pitting or corrosion.
- Inability to hinge freely.
- Weld splatter.

4.5 Wire Rope



Examples of common wear and defects in wire rope

Images: FPInnovations Steep Slope Initiative

Appendix A: Sample Training Guide for SSM Equipment Operations

This is a sample guide and contents should be changed to meet your specific operations and hazards.

Prior to being allowed to operate on a SSM the operator should have operated a similar machine not attached to a winch for a minimum of two months and/or be able to demonstrate competence as an operator. For the first user of a SSM machine, a suggestion is to work on ground with a low enough slope (under 35%) that the tether is not required. This allows for training on machine operation with a tether in a low hazard environment. Subsequent training should be performed on gradually steeper slopes. The training must take place under the supervision of a qualified and competent operator and be documented.

Evaluate the SSM operator at 30 days after training is completed and at a minimum annually thereafter.

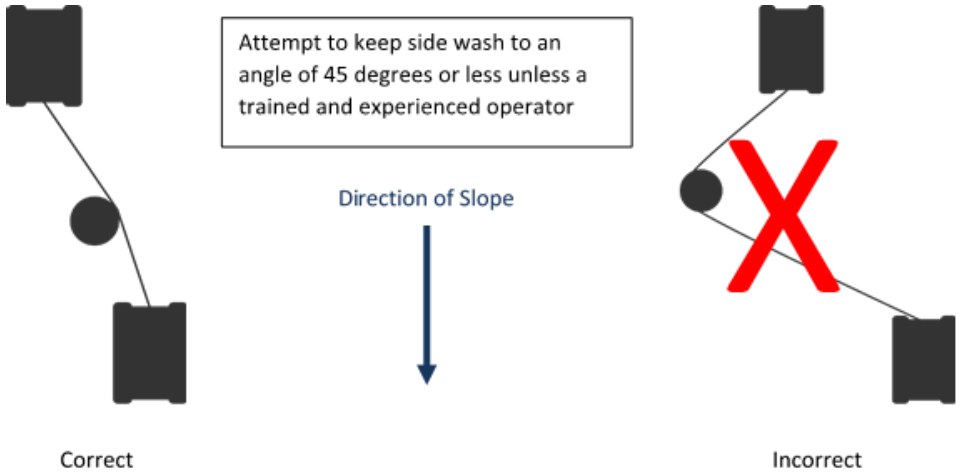
Train to each of the following:

- ☐ PPE Requirements:
  - Boots that support ankles must be worn at all times (caulk boots if walking on logs).
  - Hard hat worn when out of the cab.
  - Gloves available and worn when handling wire rope.
  - Chaps if operating power saw.
  - Hearing protection if required.
- ☐ Three points of contact used when getting in or off the machine.
- ☐ Review the operator's manual and keep a copy in the cab of the machine.
- ☐ Four point harness or restraining devices to be worn at all times.
- ☐ Check in and out procedures:
  - Check in with designated person at start of shift.
  - Communicate at least every two hours when on slopes over 80%.
  - Check out at end of shift.
- ☐ Lockout/Tagout (LOTO) procedures for each machine being used.
- ☐ Knowledge of all safety functions of the machine.
- ☐ How to inspect all components of the tethered system and frequency of inspection (see example guide).
  - Wire rope

- Shackles
- End connections
- Blocks
- Sheaves
- Wire rope spooling

☐ Inspection and use of wire rope. This training is best performed by a person competent in the use of wire rope.

☐ Side wash
- If there is a sheave on the base machine and it is at full angle do not side wash.
- Only side wash if needed – first try to move base machine or to a different stump.
- Understand hazards associated with side wash, when to use, and its limitations.
- Keep side wash stumps high enough so there is not a chance of the wire rope slipping off.
- Have a backup stump or tree in the event the stump or tree is pulled or the wire rope slides off.
- The stump needs to be able to support the pressure that will be applied.
- Have a second stump or tree in close proximity that the wire rope will catch in case the stump or tree fails. If using a two wire rope machine have each wire rope redirect over its own stump.
- Try to utilize the terrain to take up tension (example wire rope over ridge).
- Ensure that stumps and trees are large enough to be safely used.
- Do not allow inexperienced operators to side wash more than 45 degrees until they have been effectively trained on the hazards associated with side washing, how to choose stumps and trees, and when to use and not use side washing.
- Do not intentionally side wash more than once on a strip.



- ☐ If machine(s) or components need repair, report and correct prior to operating.
- ☐ How to check fluids in the machine.
- ☐ Routine maintenance (e.g., greasing, changing chains, hydraulic hoses, etc.).
- ☐ Safe operating distances: A distance of two tree lengths must be maintained between workers and work areas.
- ☐ How to inspect each machine before operating; areas to train are inspections of:
  - Hand rails
  - Steps
  - Windows
  - Computer systems
  - Communications
  - Guards
- ☐ Review how to inspect that all safety functions are properly working.
- ☐ Emergency medical plan is onsite, able to read it, and in an identified location.
- ☐ At any time the operator feels unsafe they have the right to stop operating.
- ☐ Check soil and weather conditions continuously and if there is a change that make operations unsafe cease work.
- ☐ If there is a chance of debris rolling or sliding downhill to a road, working space, or equipment block road or stop operations until remediated.
- ☐ If there are trees above the SSM that are not stable, move them downhill until stable.
- ☐ If feeding logs to another machine below and there is a chance of logs or debris sliding or rolling downhill, have lower machine move to a safe location until the hazard is not present. Good communication between operators is necessary.
- ☐ Use a steep slope hazard assessment before operating (Appendix D).
- ☐ Felling:
  - Do not operate the SSM on a side slope. Keep tracks of machine directed down the hill.
  - For non-auto tension machines, winch in slack in the wire rope before operating.
  - Hand fell trees too large to be felled safety with an SSM.
  - Only experienced operators can fall oversize trees with a SSM (trees that require multiple cuts due to diameter); otherwise trees must be felled by hand.
  - If a tree must be left with a partial cut, mark the area and warn all affected personnel of the hazard tree.
  - Limit the time the cutting disc is positioned over wire ropes and chains.

- Use operation and maintenance practices that mitigate chain shot hazards. (Appendix B: Chain Shot Awareness and Training)
- Ensure that operators know how the tethering system functions, and how important wire rope tension is to the safety of the operation. Poor understanding of wire rope tension can increase safety hazards.
- Fall trees into the open whenever possible. This will keep ground visibility better in areas not yet operated, decrease overhead hazards when out of the cab, and create less hazards for the next phase.
- Keep slash, downed logs, and other debris clear of the front of the machine to increase ground visibility and minimize traction loss.
- If bunching for a yarder, size each pile to fit one choker (2-4 logs). If possible, set piles so there is a spot to get a choker under them with good ends.
- Try to plan the lay and how trees will be felled at least four trees in advance.
- Pile brush in an area that will not affect the rigging crew or hand fallers activities. When possible, create walking paths for ground crews.

☐ Traveling:

- Know your comfort zone and do not operate beyond.
- Operate machine as if there was not a wire rope attached.
- Keep winch(es) on auto mode unless manual mode is needed for a safety reason.
- Ensure that wire ropes do not get hung up and create an unintentional side wash. If this occurs, slack the wire rope (if safe to do so) and move it.
- If winch sheave is greater than 45 degrees, the pull is directed more onto the boom of the base machine and machine should be moved. Understand the system and follow manufacturer's recommendations.
- Keep debris clear in front of machine so ground can be seen.
- Turn off cutting discs when walking the SSM uphill and not actively cutting.
- If creating large ruts, use chunks to reduce ground disturbance or discontinue operations before ruts get too big. Or fill in after operations/follow landowners requirements.
- Be aware of soil and topography changes, and how the changes will affect stability.
- If terrain (divots or holes) will cause machine to loose stability, side-to-side chunk those areas.
- Monitor wire rope tension and availability constantly.
- If getting out of signal range, stop operations until signal is reestablished.
- Do not travel on side hills, keep tracks as parallel to hill as possible.

- ☐ Logging:
  - Log with butts facing downhill (if logging downhill).
  - If any machines, people, or roads have the potential to slide or roll downhill, block off that area or have lower operations move to a safe location until it is safe for them to return.
  - If piles above the machine become unstable and have the potential to roll or slide into the machine, move them.
  - Know and adhere to the machine's limitations.
- ☐ Base Machines
  - Follow manufacturer's recommendations.
  - Setup of base machine is very important; take time in planning.
  - If using an excavator-type base machine, have boom at a minimum of 90 degrees.
  - Keep tracks as parallel to hill slope as possible.
  - Avoid setting up on soft shoulders and edges of roads.
  - Keep boom or bucket grounded while operating SSM.
  - Keep machine as level as possible.
  - Have dirt pushed up in front of blade or bucket dug in when possible.
  - Chain bucket to the machine as recommended by the manufacturer, or when the bucket cannot be dug in due to soil conditions.
  - Inspect daily and any time there is a possibility that damage occurred.
  - Properly set and use all monitoring devices that sense movement of machine.
  - Manual operation of tethering system is only allowed in emergency situations (such as breakdown of SSM).
  - Place signs or close road.
  - Ensure all computers and communications are functioning properly, and if not, do not operate until corrected.
- ☐ If using spliced eyes, the operator must know how to splice eyes or have a competent person available to assist. The operator must know how to inspect spliced eyes. All eyes must be at least three tuck.
- ☐ Stump Anchors:
  - Inspect at the start of each shift and anytime a hard pull or increased tension was placed on a stump.
  - Must be carefully chosen for position, height, and strength. When necessary, stump anchors must be tied back to distribute the load.
  - Each species of tree has a different root system and grows differently according to the soil moisture, density, and slope. The holding power of a stump increases

with soil depth and density. Never assume the stumps in one setting will be the same as stumps in the next setting.

- Stumps are generally strongest with a side pull rather than an upward pull. On slopes, stumps have more root structure on the downhill side, and are therefore stronger on an uphill, rather than downhill, pull. Stumps on the back side of a ridge, with an upward pull, are stronger.

Appendix B: Chain Shot Awareness and Training

See WAC 296-54-52001

Employee _____ Trainer _____ Date _____

All employees who operate or work around or perform maintenance and or repair of any kind of machinery equipped with a hydraulic powered bar saw must receive “chain shot” awareness training appropriate to their job.

Note: Employers who have employees who are potentially exposed to chain shot but do not operate, inspect, or maintain the equipment can limit training to the information in Section 1.

☑ Indicates that the employee has received training.

☐ **Section 1 General information**

- Chain shot is the high velocity separation and ejection of a piece or pieces of cutting chain from the end of a broken chain in mechanized timber harvesting/processing. Chain shot exposes both machine operators and bystanders to a risk of serious injury or death. Chain shot typically occurs near the drive end of the cutting system but can also come from the bar tip area.
- A chain shot consists of two breaks in a chain. First, the loop of chain breaks and forms two ends. One end moves past the drive sprocket or bar nose and is rapidly accelerated due to a whip-like motion of the chain end. The "whip action" causes the second break releasing small parts at extremely high speed.
- The “shot cone zone” is the area along the plane of the guide bar where pieces of a broken chain usually travel unless pieces are deflected. The SCZ angles out approximately a 15 degree angle on both sides of the guide bar and a distance that possibly exceeds 230 feet.
- Employees should stay clear of the shot cone zone.

☐ Section 2 Cutting system inspection

The cutting system must be inspected before initial use during each work shift. Defective parts that would make the cutting system unsafe to operate, must be replaced or repaired before the cutting system is placed in service. Report unsafe conditions to your supervisor.

Inspections must include:

- The lubrication system for leaks or damage.
- The chain for cracks or worn/damaged parts.
- The bar for wear and straightness and ensure the tip is properly secured.
- The sprocket.
- The chain catcher if equipped.
- The chain shot guard if equipped.

☐ Section 3 Cutting system maintenance

- Sharpen, assemble and repair chains in accordance with the manufacturer's specifications.
- Maintain proper bar and chain lubrication, making sure to use the right type and amount of lubricant.
- Replace the drive sprocket when it has excessive wear.
- Clean guide bar grooves and oil port holes regularly.
- Guide bars should be flipped regularly to ensure even wear.

☐ Section 4 Cutting system operation

- The operator and other persons should be kept clear of the shot cone zone.
- Follow chain manufacturer’s recommendations for chain speed. “Boosting” or exceeding the recommended chain speed is prohibited.
- Maintain proper chain tension.

Appendix C: Operator Audit Form Sample

Date:

Auditor:

Operator: Operator experience:

Job:

Pre-Job

- ☐ Pre-job safety meeting held
- ☐ Logging plan reviewed by operator
- ☐ Emergency medical plan onsite
- ☐ Check in/on procedures being used

Weather conditions:

Soil conditions:

Base Machine

- ☐ Placed in proper location
- ☐ Machine stable
- ☐ Machine level
- ☐ Fires extinguisher/fire suppression system

Angle of pull on sheave (Approx.):

Condition of machine:

- ☐ Being inspected routinely
- ☐ Hand holds and steps in good condition
- ☐ Signs out
- ☐ Sheave in good condition
- ☐ Spooling properly
- ☐ Safety monitoring devices being used and properly placed
- ☐ Bucket or blade placed in the ground if feasible
- ☐ Machine placed in a stable location

Comments:

SSM

- ☐ Being inspected routinely
- ☐ Proper maintenance being performed
- ☐ Fire extinguisher/fire suppression system
- ☐ Hand holds and steps in good condition
- ☐ Wire ropes in good condition
- ☐ End connections
- ☐ Shackles
- ☐ No oil leaks on machine
- ☐ All computer systems working properly and proper communication with base machine

Operations

- ☐ Not closer than two tree lengths to other operations or personnel
- ☐ Training completed and documented
- ☐ Falling into open when possible
- ☐ Not operating on side hill
- ☐ Operator using seat harness
- ☐ Operator can name hazards on the job
- ☐ Operator has plan of how to accomplish job
- ☐ Operator can explain safety devices
- ☐ Side wash being used properly
    - Tree or stump adequate for use as a side wash
    - Other options available
    - Does the operator understand the hazards

Anchors

- ☐ Large enough
- ☐ Notched correctly
- ☐ Correct strap size and in good condition
- ☐ Correct shackle and good condition

Appendix D: Steep Slope Hazard Assessment and Identification

For use during pre-job planning or any time there is a significant change in job conditions.

Hazard	Low Risk	Medium Risk	High Risk
Weather	Dry conditions with no wind.	Little snow or ice, low winds, or moderate rain.	Snow and ice accumulation, high winds, or heavy constant rain.
Soil condition	Dry soil, good drainage, shallow duff, and no rock.	Moderate saturation, scattered rock, or poor drainage.	Rocky, extremely saturated, or deep duff.
Topography	No rock, little change in topography, and few or no steep draws.	Little rock, a few steep draws, or very broken.	Rocky outcrops, many steep draws, or inner gorges.
Vegetation/ground cover	Little brush and clear ground visibility.	Thick brush but able to see.	Thick brush and cannot see ground.
Timber type	No oversized, heavy leaning, or blowdown.	Few oversized and heavy leaning.	Oversized heavy leaning timber.
Percent slope	Under 60%	60%–80%	Over 80%
Length of slope	Under 500 feet	500–1,000 feet	Over 1,000 feet
Base machine position	Level, lots of room for machine, very stable.	Not level, or on road edge.	Soft road edge, on steep incline, or not stable.
Areas of concern for signal	No potential for lost or weak signal.	A few possible areas of weak or no signal.	Many areas with anticipated weak or no signal.
Harvest plan created	Plan created and discussed with all applicable personnel.	No plan but discussed.	No plan and no discussion.
Areas to be tethered are identified	Unit has been walked and clear breaks identified.	Areas identified but might change because unsure.	Unit not walked or planned.
Operator's experience	Over 1 year.	3 months to 1 year.	3 months or less.
Operator's comfort with unit	Has no concerns.	Has little concern and confident it can be done.	Voiced concerns and unsure if it can be done.
Check-in plan created	Plan to check on during day and in after shift.	Plan only to check in/on once home.	No plan for checking in/on during or after work.
Emergency operator extraction	Easy to access operator.	Some difficulties accessing.	Very steep, long ways from road, and difficult to access in case of an emergency.
Phone service	Service at the job.	Have to drive 5-15 minutes for service.	Have to drive more than 20 minutes for service.

Appendix E: Pre-job Planning Guide Sample

For use during pre-job planning or any time there is a significant change in job conditions.

Date:

Job Name:

In attendance (Names):

Reviewed with:

☐ Contract owner

☐ SSM operator

☐ Hand fallers

☐ Tower crew

☐ Land owner

☐ Others affected (adjacent logging, haul roads)

Operations

Operations: Falling and logging Bunching for other equipment

Hand fallers needed: Yes No

If yes, will hand falling occur: Prior to SSM Following SSM

Areas of concern in the unit: Yes No

If yes, what:

Have the issues been addressed: Yes No

Georeferenced PDF harvest unit map available: Yes No

Areas where the SSM will not operate marked on map or ground: Yes No

Operator is comfortable working on job site: Yes No

Operator input provided: Yes No

Equipment inspected prior to beginning operations: Yes No

Deficiencies noted have been corrected: Yes No

Site conditions

Length of slope:

Average percent of slope:

Topography:

Stand type:

Stand size:

Soil type:

Load size/ bunch size:

Suitable place for base machine, or suitable anchors: Yes No

Vegetation cover: High Medium Low

Current and expected weather conditions have been discussed: Yes No

Communication

Emergency medical plan created: Yes No

Available in a digital format: Yes No

Road control needed (Road block or Flagger): Yes No

If a flagger is needed, is communication plan established: Yes No

Check in procedures have been reviewed: Yes No

Work Alone plan needed: Yes No

Person conducting supervision:

Check-in frequency:

Appendix F: Daily Inspection Guide Sample

This is a guide. Always follow manufacturer's requirements and out of service criteria.

Machine: **Date:**

Operator/Inspector:

Daily Inspection	OK	Not OK	Comments
Rope and Attachments – Check for Damage			
End connections/shackles			
First 50' of wire rope			
Chain			
Blocks			
Hitch			
Ferrules			
Wire rope properly spooled			
Winch Machine or Anchor			
Placement of base machine			
Break-away switch or stump monitor			
Leaks			
Cracks in boom			
Welds			
Steep Slope Machine (SSM)			
Fuel level			
Oil and fluid levels			
Leaks			
Cracks in boom			
Undercarriage			
Tether mounting			
Track gear			
Hand grabs, steps, and windows			
Seatbelts or harness			
Guarding			
Items in cab secured			
Communication and Technology			
Functional CB or other communication			
Cameras			
Sensors			
Radio/remote controls			
Signage for cutting area/ operator contact			
Other Notes			

Appendix G: Washington Administrative Codes (WACs) Referenced

Title 296 WAC, Department of Labor and Industries

Chapter 296-54 Safety Standards – Logging Operations

296-54-515 **Accident Prevention Program**
- 296-54-51510 Safety Meetings
- 296-54-51530 First Aid Kits
- 296-54-51520 First Aid Training

296-54-569 **Anchoring**

296-54-513 **Arrangement of Work areas and Emergency Contact**

296-54-537 **Chain Saws**

296-54-520 **Chain Shot**

296-54-539 **Falling and Bucking**

296-54-535 **Hand and Portable Powered Tools**

296-54-523 **Inspection and Repair of Equipment and Vehicles**

296-54-517 **Lockout/Tagout Procedures**

296-54-573 **Logging Machines-General**

296-54-543 **Mechanized Falling**

296-54-521 **Motor Vehicles**

296-54-529 **Overhead Electrical Lines**

296-54-511 **Personal Protective Equipment**

296-54-547 **Rigging - General**
- 296-54-54710 Rigging Inspection
- 296-54-54730 Rigging Shackles
- 296-54-54740 Rigging Straps
- 296-54-54750 Rigging Blocks

296-54-531 **Roads**

296-54-527 **Seat Belts**

296-54-541 **Tree Pulling**

296-54-557 **Wire Rope**
- 296-54-55710 Wire Rope Cutting
- 296-54-55720 Wire Rope-Splicing
- 296-54-55730 Wire Rope-Attaching End Fastenings

296-54-577 **Yarding, Skidding, and Landing**

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