

Unit	1021
Title	Apply Grapple Yarder Operator Skills
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BC Forest Safety

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Unit Introduction

What you will learn in this unit

By the end of this unit, you will be able to demonstrate your knowledge of:

- Pre-work activities related to operating grapple yarders
- The operation of a grapple yarder
- Completing task post operations

Why it's important for you to learn this unit

It is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulations related to the work being conducted. A full list of OHSR related to this unit can be found in the relevant package.

Are you ready to take this unit?

To take this unit, you need to have completed the following units:

- 1002 – Describe Forest Industry
- 1003 – Use Safe Work Practices
- 1004 – Communication in the Workplace
- 1005 – Recognize, Evaluate, and Control Hazards Related to General Forestry
- 1006 – Describe Workplace Documentation
- 1007 – Describe Emergency Preparedness
- 1008 – Describe and Apply Workplace Attributes
- 1009 – Recognize, Evaluate, and Control Hazards Related to Yarding
- 1010 – Describe Basic Regulations and Standards
- 1011 – Describe and Access Intermediate Regulations and Standards
- 1012 – Describe, Access, and Apply Advanced Regulations and Standards
- 1013 – Describe Rigging Components and Apply Basic Rigging Practices
- 1014 – Describe and Apply Advanced Rigging Practices

Does this unit apply to you?

This unit applies to you if you are in the following occupation:

- Grapple yarder operator

Section 1021-01: Pre-work Activities

What you need to know about this section

By the end of this section, you will be able to demonstrate your knowledge or ability in the following key points:

- 1.1 Use equipment manuals and specifications to determine safe operating procedures and operational restrictions of grapple yarders
- 1.2 Hazards related to operating grapple yarders and the means to control them
- 1.3 Inspect cables and guylines
- 1.4 Determine block or slope orientation, soil conditions, and limitations
- 1.5 Develop a grapple yarder site in partnership with the hook tender
- 1.6 Perform pre-start equipment checks
- 1.7 Perform start up procedures
- 1.8 Signaling devices on a grapple yarder are working properly in accordance with regulation

Key Point 1.1: Use Equipment Manuals and Specifications to Determine Safe Operating Procedures and Operational Restrictions of Grapple Yarders

You need to be able to demonstrate your knowledge in using equipment manuals and specifications to determine safe operating procedures and the operational restrictions of grapple yarders.

Equipment manuals

Necessary operation and maintenance manuals are provided with each yarder equipment manufacturer. These manuals contain all necessary information to provide adequate information and training to those operating, maintaining, or supervising the use of this machinery in a safe and proper manner.

The operation manuals are usually available at the shop and accessible if needed. There are also maintenance inspection plaques available on the operator's door or inside the cab for daily, weekly and monthly inspection and which are a very good reference for machine operators.

Operators can find information on the size, length and number of mainlines for the machine they are operating on the Spec plate.

Periodic safety inspection

Use the following checklist along with the information provided to properly operate and maintain the yarder.

Items to be inspected	Inspection code	Satisfactory	Adjust	Repair
Visual inspection *	D			
Overall cleanliness	D			
Hydraulic system	W			
Hydraulic tank fluid level	W			
Pump drive case	W			

fluid level Heater and defroster	W			
Engine crankcase fluid level Fuel tank fluid level Radiator fluid level	** D W			
Transmission fluid level Air system All control mechanisms	** D D			
Instruments and gauges Warning lights Muffler exhaust system	D D D			
Swing reduction fluid level Traction drive case fluid level Air cleaner element signal	D M W			
Fan belt tension Batteries and starting system Gear bearings	D W M			
Gears lubrication Chain case fluid level Air lubricator	D W W			
Ring gear bolt torque Track adjustment Guards and catwalks	P P P			
D – Daily	W – Weekly	M – Monthly	P – Periodic	

* Inspect the entire machine for cracks, weld separation, leaks, damage, and evidence of vandalism

** See manufacturer's manual

Key Point 1.2: Hazards Related to Operating Grapple Yarders and the Means to Control Them

Hazards related to operating grapple yarders include (but not limited to) the following:

- Runaway logs and debris
- Swinging chokers
- Log piles
- Counterweight clearance
- Weather
- Night operations
- Tailhold blocks
- Deteriorated topping or gantry lines
- Dees, thimbles, and cable clips
- Spooling and cutting lines
- Windows
- Grapple yarder access
- Line pulling of trees

Runaway logs and debris

Yarding downhill must be done at an angle to the grade so that runaway logs and debris cannot slide into the landing. During downhill yarding on steep slopes, logs are more difficult to control, thereby increasing the danger of runaway logs and jill-pokes into the tracks, carrier, and cab windows.

Side bound lines are common in logging and potentially dangerous. A line that clears as a log is being landed may cause the log to move further ahead than expected and strike the machine. Hitchhiker logs may move independently and create a hazard. Make sure you deal with the following before the log reaches the landing:

- Hitchhikers
- Saplings
- Loose chunks
- Loose logs



Runaway logs are extremely hazardous

Swinging chokers

Lack of adequate line deflection sometimes requires the use of a choker to yard logs that are close to the tailblocks. Often the choker is left on when grapple yarding is taking place. The hazard of a loose choker swinging overhead endangers the operator and ground workers during yarding operations and road changes. Remember to remove the choker when not in use.

Log piles

Landings of inadequate size make landing of logs difficult and dangerous. In tight landings, logs must still be swung and manipulated, but it may be difficult to maintain the minimum counterweight clearance.

All log piles must be maintained in a stable condition.



Unstable logs make landing logs hazardous

Counterweight clearances

The operator of the yarder must know the location of workers and other equipment or machinery. As a safety measure, a minimum clearance of 60 cm (2 ft.) between the counterweight of the yarder and any other obstacle must be maintained.



Minimum counterweight must be 60 cm (2 ft.)

Weather

Good visibility is important for both safety and production. When fog or snow restricts visibility and makes the grapple, logs, or the back of the pile not clearly visible, yarding must be stopped because runaway, upending, or swinging logs cannot be seen. When ice or snow-covered logs prevent building a stable and secure pile, yarding must stop until the pile is broken down.

Night operations

Powerful lighting systems used for night operations produce strong contrasts of light and dark, making walking in the felled and bucked area very hazardous. For the operator to see ground crews, they must wear hi-vis clothing with reflective strips. The machine must be equipped with side lights. During night operations, audible or verbal radio signals must be used instead of hand signals.

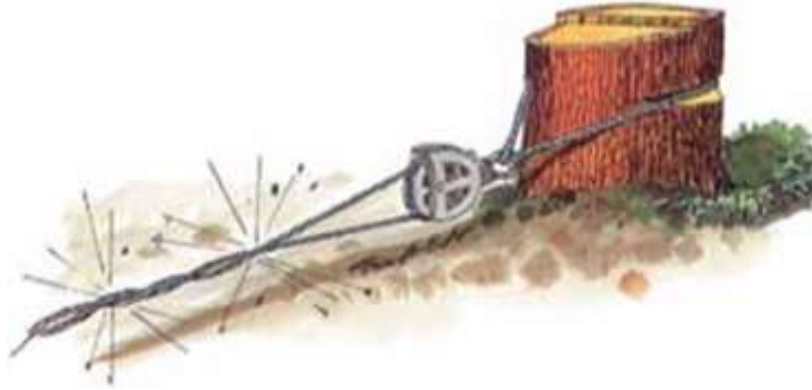
All night yarding operations must have written supplementary instructions to adequately deal with additional hazards and procedures, including person-check procedures, backspaw operation, and maintenance of lighting systems.

Tailhold blocks

Wire-rope manufacturer's recommended ratio used to determine the correct sheave to line size is 30:1, where each centimetre (or inch) of line diameter requires 30 centimetres (or inches) of sheave diameter.

The actual industry standard is 20:1. This ratio permits smaller blocks to be used, but it does cause premature line wear.

A single block is often used where there is a two-person crew as the hooktender is alone. Although a single block is easier for one worker, there is the disadvantage of severe line-wrap. The haulback must make a sharper bend around the sheave, which generates heat, causing drying of the lubricant and premature wear.

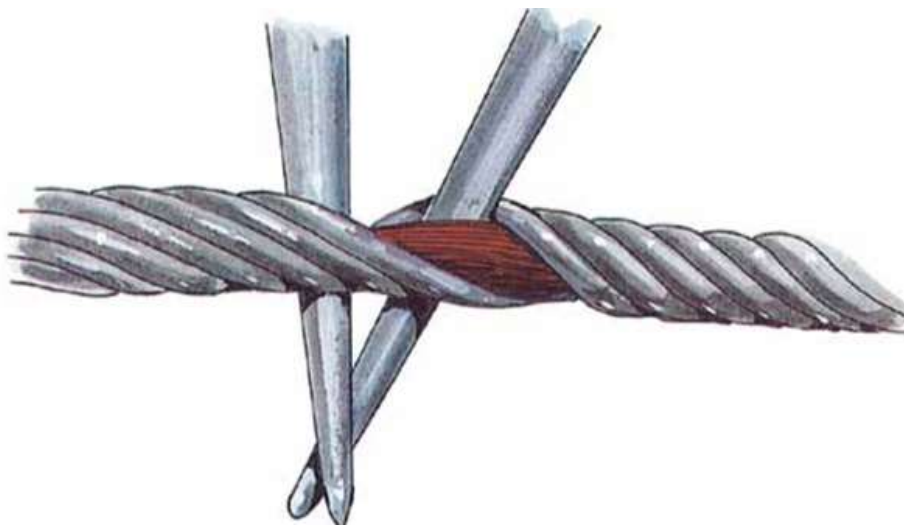


Single block with line crossing and burning

A two-block system is more work for the hooktender but line-wrap is greatly reduced, increasing line life. The use of a backspar crawler tractor or hoe has simplified the back end in that larger or double sheaves can be used.

Deteriorated topping or gantry lines

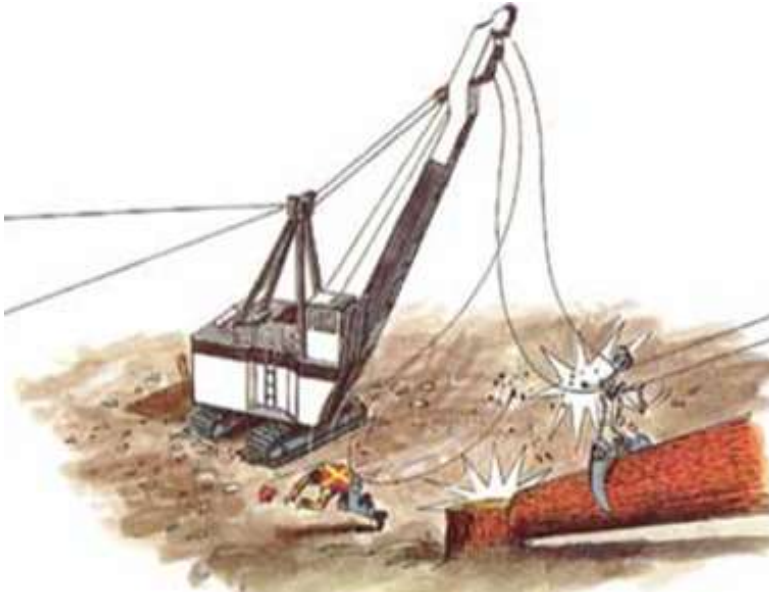
Topping or gantry lines are critical components and should be replaced annually. These lines must be inspected regularly for wear and wire core lubrication. All line changes and inspections must be recorded in a line book.



Line must be replaced when the core is dry with broken lines

Dees, thimbles, and cable clips

Mainline dee connectors must be inspected twice per day. To inspect for excessive line wear at the dee connector, slide the dee to expose the line.

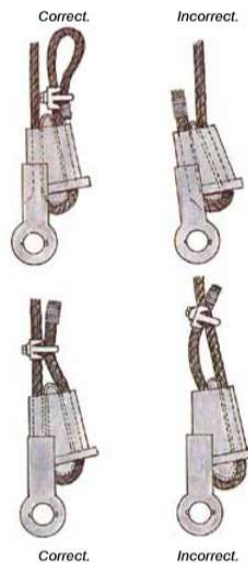


Mainline dee connector fails. The end will slip into the landing

Rigging considerations

The following are rigging considerations to remember:

- Make sure the eye of the topping line tailhold has a steel thimble at the pin
- Make sure wedge-type socket tailholds are installed correctly with the pull in direct line with the pin
- Make sure that cable clip saddle are installed on the live line



Spooling and cutting lines

The operator must not operate the machine and spool lines simultaneously. Proper spooling tools are to be used. Makeshift spooling tools such as a hammer or axe must not be used.

If a hammer is to be used to cut or splice a line, it must be a soft hammer identified by a small "S" stamped on one of the side faces. With use, these hammers become mushroomed and pieces may chip off. Such chips have been known to cause eye injury to workers up to 6 m (20 ft.) away.

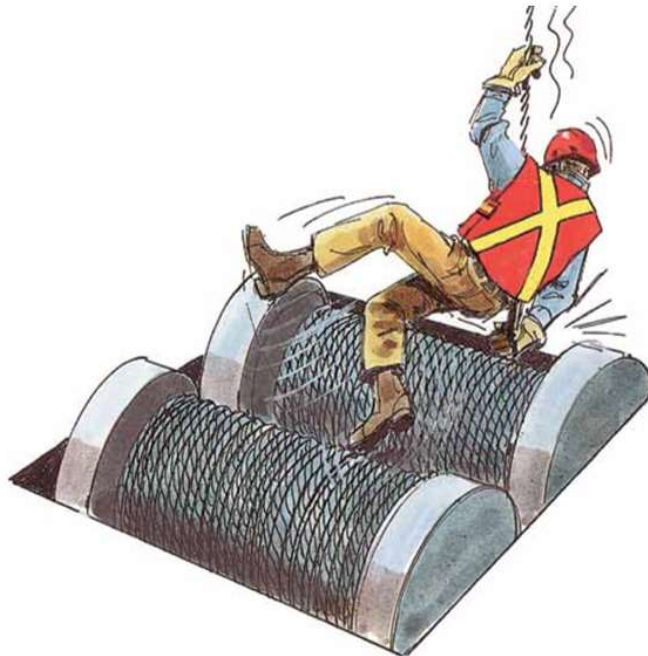
Remember the following when spooling and cutting lines:

- Hammers with mushroomed heads must be replaced
- Cutting tools should be sharp and of proper hardness
- Eye protection must be worn during any cutting procedure
- Maintain the proper tip profile on Marlin spikes
- Always use a proper spooling tool when spooling running lines



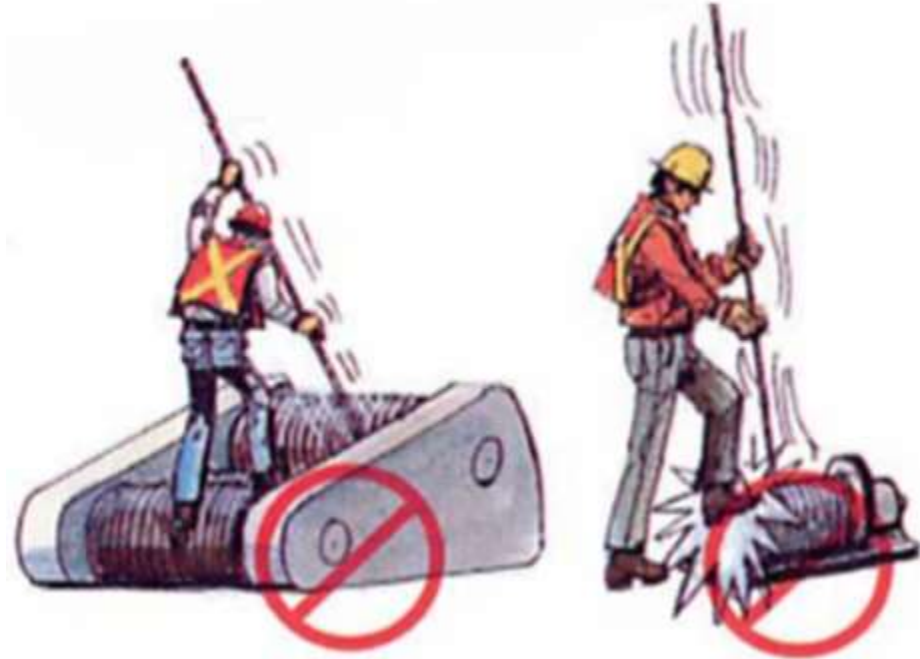
Examples of spooling hooks

- All access routes and work platforms used when spooling lines must be covered with non-slip material



Do not spool lines by hand. Jiggers can catch the gloves

- Avoid walking on metal surfaces in caulk boots



- Stand with both feet on the platform



Windows

Cab windows are intended to protect the operator from the natural elements and must be replaced if missing or damaged. Visibility is affected by dirty glazing and by glare caused by sunlight on “spider webbing” in cracked or broken glazing. Windows must be kept clean and must be replaced if cracked. Blinds may be installed to reduce the sun’s glare.



Too much glare through a cracked window could result in poor visibility

Grapple yarder access

When greasing pins and sheaves at the top of the gantry, the worker should wear a safety belt attached to a lifeline or anchor. A ring, cage, or other guardrail can be installed to prevent falling.



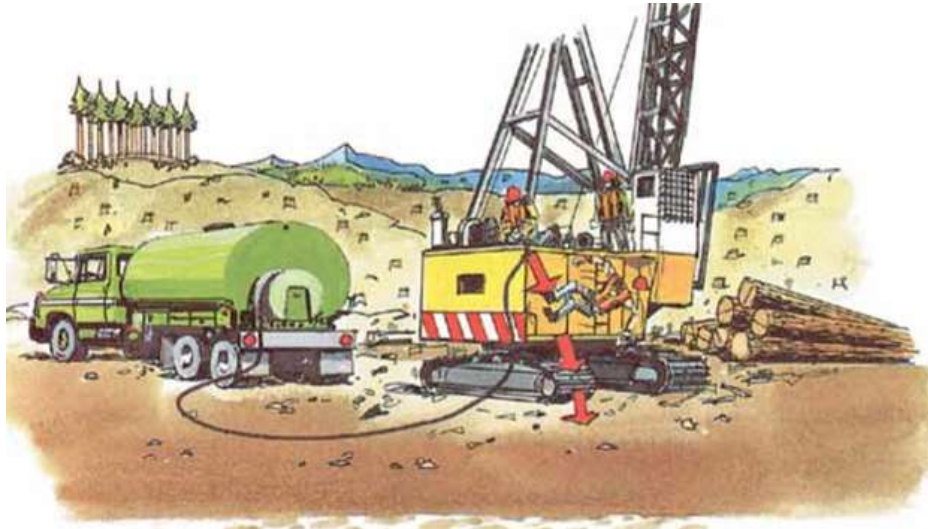
IMPORTANT!

All access ladders must be securely fastened. Broken or damaged ladders must be repaired or replaced.

When a machine is behind the log pile, getting into and out of the machine can be dangerous. If it is necessary for the operator to walk logs to get to the machine, caulk boots must be worn. If the log pile is unstable with crossed or hazardous logs, the log pile must not be used for access, an alternative route must be chosen.

A person-check system must be in place when the worker is alone.

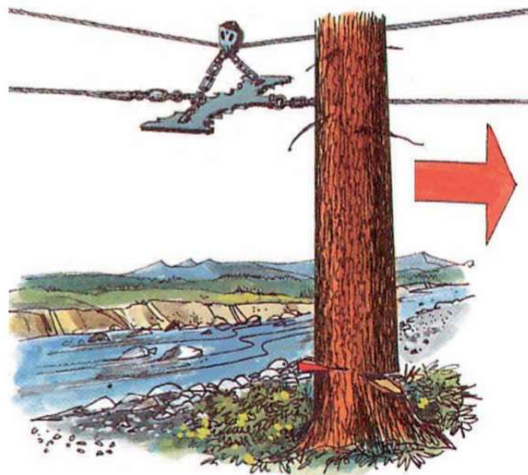
The absence of anti-slip decking or handrails creates hazards. A fall protection system must be used if a worker is working on heights over 3 m (10 ft.).



Line pulling of trees

Line pulling of trees require written supplementary instructions. Because of the hazards involved, all workers must have the procedures reviewed with them before pulling trees over.

An effective method of pulling trees over is the use of a “bat wing” or equivalent. The apparatus is placed behind the tree to be pulled. A faller places appropriate falling cuts, then the tree is pulled over. No worker is required to climb the tree to apply a pulling line.



A bat wing may be used to pull trees over

Grapple yarder hazards

Grapple yarder hazards include the following:

- Walking the grapple yarder
- Culverts and bridges
- Overhead obstructions
- Travelling uphill and downhill

Walking the grapple yarder

On established roads there are fewer hazards, provided the road is of sufficient width. Hazards do develop on newly constructed haul roads. Often roads or spur roads are constructed barely wide enough for the tracks. The operator is then forced to walk off centre of the road to the uphill side, with the tracks or tires close to or in the ditch. In that position, the machine can tip sideways. Roads not adequately benched or built with loose side-cast material could give way under the weight and vibration of the grapple yarder.



When the road is too narrow the grapple yarder can be off centre resulting in sideways tipping

Culverts and bridges

Metal, plastic, and log culverts, if not adequately bedded, can shift and collapse. The yarder must not be turned when it is over a culvert. Plugged culverts can wash out under the road surface and collapse. Bridges must be inspected periodically to ensure that the structure is capable of with standing the load.



Bridges must be inspected to ensure they can support the loads imposed upon them

Overhead obstructions

One hazard while moving the yarder is getting in contact with a power line.



When passing under power lines, make sure the boom is lowered.

Watch for low power lines in camp areas. Have a spotter to direct travel when crossing under power lines.

Travelling uphill and downhill

The grapple yarder should face uphill with the boom turned to the uphill side to ensure that the boom does not flop back. The strawline should be used to secure the grapple. Having the machine and grapple facing downhill changes the centre of gravity, increasing the risk of tipping forward. When on a steep grade, the grapple yarder must be pushed, pulled, or snubbed. Rigging and lines must be matched in strength to the equipment used for snubbing. If the yarder is driven hydraulically, do not pull faster than the designed travel speed.



Machine facing uphill, the boom swings around breaking the swing shaft and the brakes do not hold



Machine facing downhill at a 20% grade and travelling. When the brakes are applied, the machine nosedives



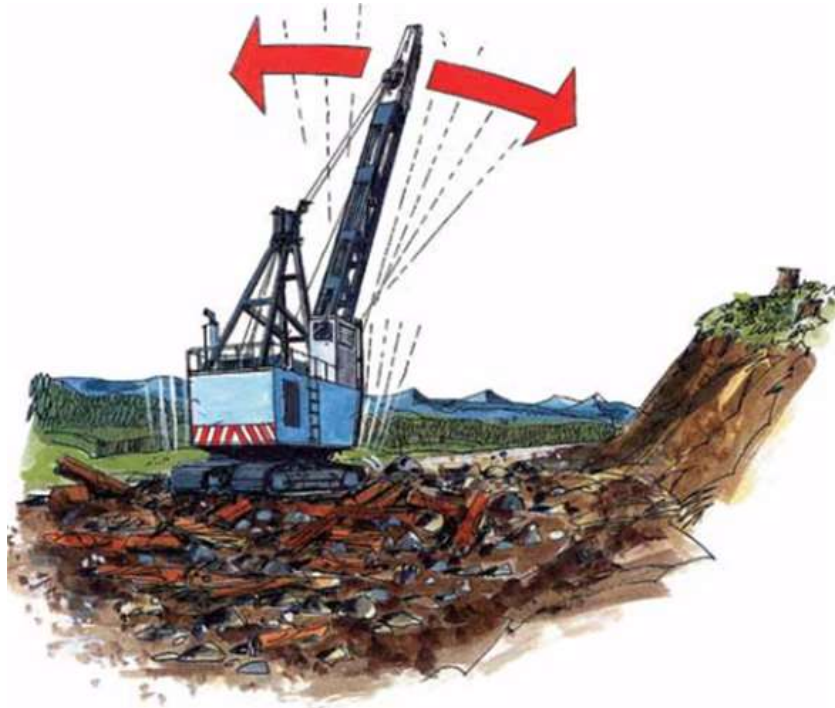
Grade is too steep, the brakes lock up and the machine runs away since no snubbing vehicle is hooked up

Roads covered with debris or snow

When travelling on debris-covered roads, jill-pokes are common, resulting in air lines being broken and tracks derailed. When roads are covered with ice or snow, it is difficult to determine the stability of the road. The road edge may not be visible, or there can be poor traction. Keep the road clear, and be aware of loss of traction from ice buildup between the grousers.

Rock protrusions

Rock protrusions are common on poorly built and poorly maintained roads. These protrusions can cause severe vibration, bounce, and jarring. Such severe movements cause equipment damage and loss of control by the operator.



Walking over road protrusions causes severe shake and can adversely affect the operator

Now try the quiz on the next page.

Hazards Related to Operating Grapple Yarders and the Means to Control Them—Self-Quiz

1. What is the minimum clearance for safety measure between the counterweight of the yarder and any other obstacle?
 - ☐ 40 cm
 - ☐ 50 cm
 - ☐ 60 cm
 - ☐ 70 cm
 2. What is the recommended ratio used to determine the correct sheave to line size by wire-rope manufacturers?
 - ☐ 15:1
 - ☐ 20:1
 - ☐ 25:1
 - ☐ 30:1
 3. The grapple yarder should face uphill with the boom turned to the uphill side to ensure that the boom does not flop back.
 - ☐ True
 - ☐ False
 4. Roads not adequately benched or built with loose side-cast material could give way under the weight and vibration of the grapple yarder.
 - ☐ True
 - ☐ False
-



Now check your answers on the next page.

Hazards Related to Operating Grapple Yarders and the Means to Control Them—Quiz Answers

1. What is the minimum clearance for safety measure between the counterweight of the yarder and any other obstacle?

Answer: **60 cm**

2. What is the recommended ratio used to determine the correct sheave to line size by wire-rope manufacturers?

Answer: **30:1**

3. The grapple yarder should face uphill with the boom turned to the uphill side to ensure that the boom does not flop back.

Answer: **True**

4. Roads not adequately benched or built with loose side-cast material could give way under the weight and vibration of the grapple yarder.

Answer: **True**

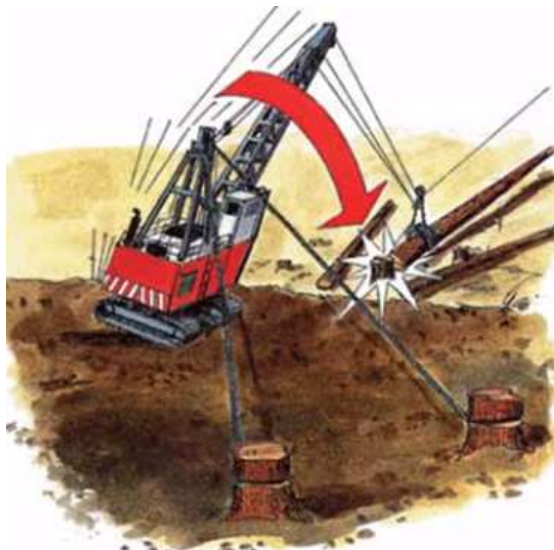
Key Point 1.3: Inspect Cables and Guylines

Guylines

Grapple yarders are manufactured with at least one guyline. The manufacturer requires that the guylines be used. The manufacturer's specifications must be followed. Yarding without a guyline is contrary to the manufacturer's specifications and increases the chance of tipping the grapple yarder.

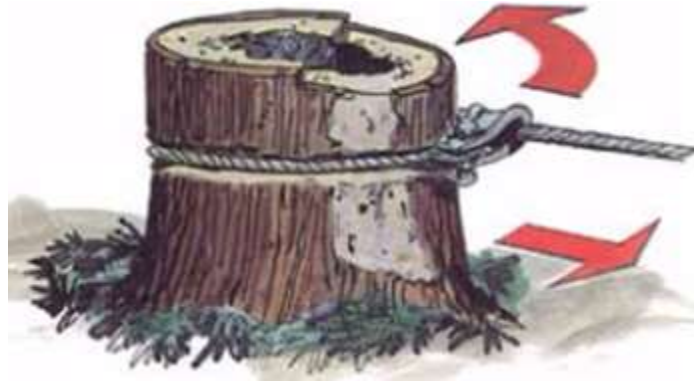


A grapple yarder with a single guyline out of lead can be pulled over

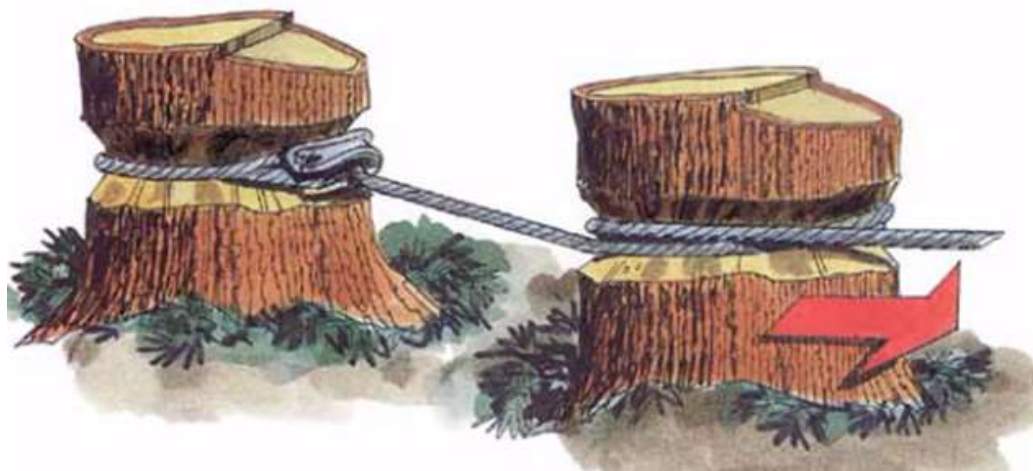


A grapple yarder severely out of lead of the two guylines can be pulled over

The guyline stumps must be properly notched and, when required, tied back with twisters or a wrap of the guyline. The hook tender must inspect the stumps daily to ensure that they are secure.

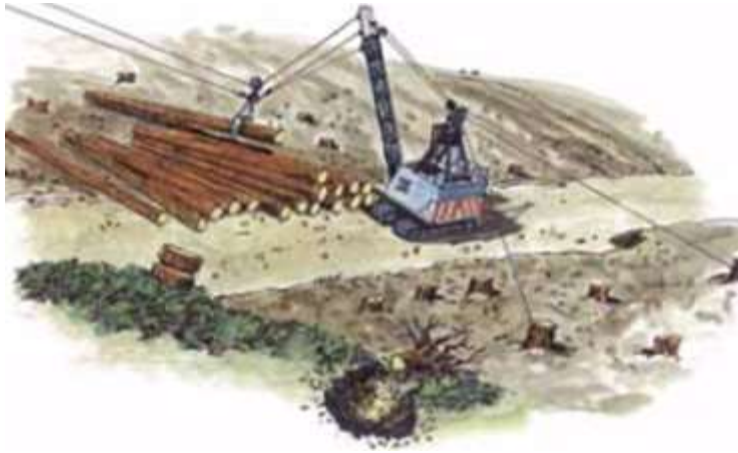


Improperly notched (too shallow) stump. Guyline bight is facing the wrong way



Properly notched stumps with the bight facing the correct way. Stump is tied back with one wrap on the front stump

If a crawler tractor is used for a guyline tailhold it must be kept in lead with the blade down and brakes set. The operator must not sit on the machine while yarding is in progress. The grapple yarder operator must ensure that guylines are kept in proper lead to share the stresses equally. Failure to monitor the lead of the guylines can result in pulled tailholds, broken guylines and equipment, road damage, and serious injury. The guyline tailholds must be changed as the yarder moves so that they are kept in lead with the yarding lines.



These guylines are in proper lead



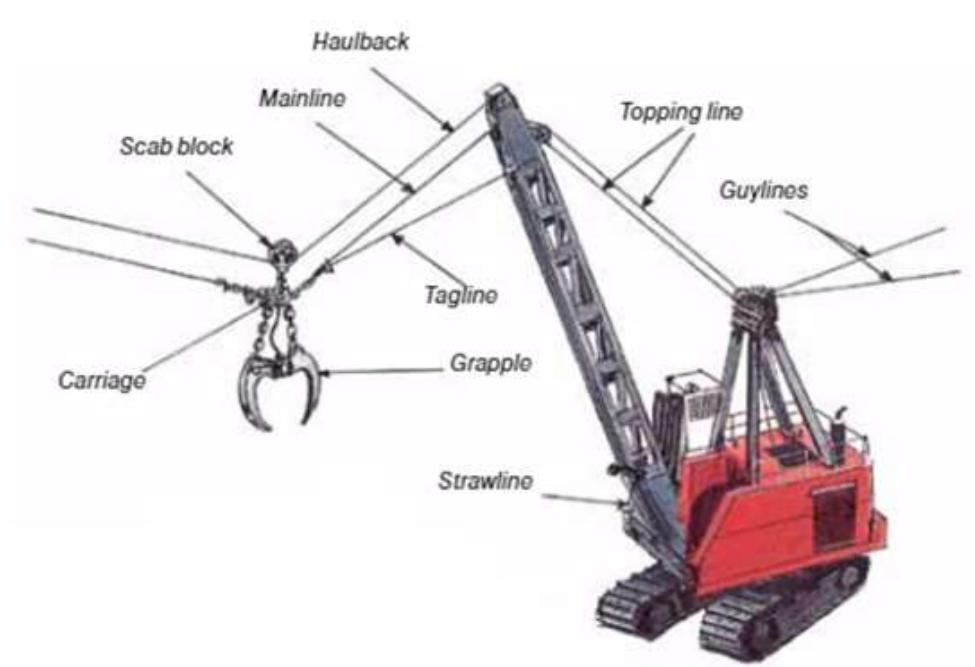
These guylines are out of lead, causing stump pull and machine rocking

Yarding lines

There are two yarding line arrangements on grapple yarders. One has opening and closing mainlines and a haulback. The other has a single mainline, a small opening tagline, and a haulback. The grapple on both is hung from a carriage, which rides on the bight of the haulback. The critical wear points of the yarding lines are at the terminals of the lines.

Daily inspections must be made where the mainline and opening lines pass through the plates. The knob and line must be pushed through so a proper inspection can be done. The area where the knob rests against the end plate must be watched closely because the knob wears a groove in the plate. When the wear becomes excessive, it crooks the line and reduces the line capacity. In extreme cases, the edge of the hole in the plate cuts the line off when it is under load. If a mainline terminal fails, the line whips toward the yarder, endangering workers. The top and bottom sections of the haulback run close together on a grapple yarder. The wrapping-up of

the haulback can be minimized by using a steel swivel hung to separate the top and bottom of the haulback. Two tailhold stumps also achieve the same purpose when stump rigging is used.



A typical tag-equipped grapple yarder

Now try the quiz on the next page.

Inspect Cables and Guylines—Self-Quiz

1. Grapple yarders are manufactured with at least two guylines.
☐ True
☐ False
2. It is the hook tender's responsibility to inspect the stumps daily to ensure that they are secure.
☐ True
☐ False
3. If a crawler tractor is used for a guyline tailhold, it must be kept in lead with the blade down and brakes set, and the operator must sit on the machine while yarding is in progress
☐ True
☐ False
4. The critical wear points of the yarding lines are at the terminals of the lines.
☐ True
☐ False



Now check your answers on the next page.

Inspect Cables and Guylines—Quiz Answers

1. Grapple yarders are manufactured with at least two guylines.

Answer: **False**

2. It is hook tender's responsibility to inspect the stumps daily to ensure that they are secure.

Answer: **True**

3. If a crawler tractor is used for a guyline tailhold, it must be kept in lead with the blade down and brakes set, and the operator must sit on the machine while yarding is in progress

Answer: **False**

4. The critical wear points of the yarding lines are at the terminals of the lines.

Answer: **True**

Key Point 1.4: Determine Block or Slope Orientation, Soil Conditions, and Limitations

Worker safety and environmental considerations

There is an increased requirement for standing trees to be left in areas that previously would have been clear-cut. These partial cuts range from selection cuts to clear-cuts with retained patches.

The primary drivers for these non-clear-cut harvesting prescriptions are biodiversity, water quality for fish, forest structure, soil disturbance/site degradation, and visual impact.

These harvesting prescriptions present significant but manageable safety challenges for cable loggers.

The established standard industry safe work practices and procedures can be accommodated by effective planning, supervision, and training of both the forestry engineers and harvesting crews.

Forestry engineers must know about task-specific harvesting work procedures. Harvesting crews must know about the specific goals and objectives of the harvesting prescription and logging plan. Employers must ensure communication and sharing of knowledge in the development of the silviculture plan, logging plan, and the harvesting of the block. There are common safety considerations that planners and cable loggers must address.

Falling non-clear-cut prescriptions

The site plan and logging plan must allow for:

- Trees to be felled without the unnecessary brushing of standing timber
- Removal of over-the-line danger trees and trees that present a hazard to workers. The specific areas to be monitored are Riparian Management and Reserve Zones, Gully Management Zones, Wildlife Tree Patches, and areas adjacent to side and back lines
- Faller substitution of one leave tree for another
- Limitation of upslope falling of trees to within acceptable industry standards
- Removal of trees that interfere with the rig-up or that could be pushed or pulled into the work area

- Fallers should know the intended yarding direction for the trees they are falling

Fallers should have plasticized maps that clearly indicate the boundaries of all residual areas, corridors, landing locations, and backspars.

By knowing the specific type of equipment and rigging, fallers can establish a falling plan that will minimize residual tree damage and site disturbances. An informed falling crew will eliminate controllable hazards for rigging crews and landing workers. Hazards controlled by fallers also reduce the number of additional hazards that rigging crews face.

Log landing areas

Increased pressure to minimize site degradation is being reflected in the reduction in size of log landing areas. Landings must be constructed to safely accommodate all the required equipment and functions, as well as to provide safe work areas for ground workers.

Landings must be large enough to land two-thirds of the length of the average log being yarded. Landings can be classified as temporary structures and rebuilt once harvesting is finished. Guylines must be secured to suitable anchors. This will require that guyline corridors be felled in some areas. Yarding corridors should be flared at the landing to prevent trees being yarded onto the equipment and workers. Trees that will interfere with the rig-up, landing of the logs, or the loading process must be removed.

Corridors

Corridors must be wide enough to facilitate safe yarding of logs. This will be a function of deflection, equipment size, timber size and height, and log length. Corridors should be clear-cut and flared at the landing. Where possible, corridors should be angled slightly cross-slope for uphill yarding.

Cross-slope movement of the yarding lines

Planners and logging crews must minimize hazards created by the yarding lines striking standing trees on the edges of corridors. Under no circumstances should the yarding lines create widow makers in the crowns of trees. The use of designated “rub trees” is acceptable provided the trees’ stability is assured. If a rub tree becomes unstable, it must be removed immediately.

Runaway log hazard

Straight downhill yarding on steep slopes is prohibited. Straight uphill yarding should be limited to slopes upon which there is no significant hazard to the rigging crews. On blocks where it is feasible, given the prescription, angle the corridors cross-slope so that the rigging crew is up-slope of the turn. Where no practical alternative exists to

straight uphill yarding corridors on steep ground, the crew must walk a sufficient distance, cross-slope, to be clear of the runaway log hazard. Activities in the landing that may dislodge materials must be stopped when the downslope crew is in the hazard area.

Overhead hazards

There can be a significant increase in overhead hazards in partial cuts or intermediate cuts. Brushing of trees increases with the density of the residual stems. It is desirable to have the block felled well ahead of yarding activity. This increases the likelihood that residual trees will have the small broken limbs blown out of them by the wind. If the residual density is high and freshly felled, work should stop if the wind comes up past 15–20 km/h (10–15 mph). Rigging crews must be aware of any forest health issues such as root rot. This will alert them to potential unstable trees missed by the fallers. There is a significant hazard of trees being yarded over or snapped off by the tong line if the positioning of the carriage and placing of chokers is poor. Logs that are being laterally yarded to the carriage should be bucked to facilitate clear yarding. Logs should not be “powered” out of the hang-up position. Rub trees that have been overused by the yarding crew or poorly selected by the planners or fallers may become hazardous very quickly. Hazardous rub trees must be removed immediately.

Fallers will quit work at those wind speeds or at least wait for the hazard to abate. Rigging or harvesting crews can work at higher wind speeds. Company policy will state at what wind speed the rigging crew will shut down if they are in an area where overhead hazards are present.

Windthrow

There is a significant increase in windthrow hazards in the following areas:

- Partial cuts in which a sufficient number of stems per hectare have been removed, reducing inter crown damping
- Riparian and Gully Management areas in which the edges have not been feathered or the crowns reduced
- Side and back lines laid out without sufficient consideration of predominant wind in relation to elevation and topographic features

Cable yarding crews must have written wind speed shutdown criteria to ensure control of the wind-throw hazard. The operation should also have administrative procedures to control post wind-throw hazards, such as leaning trees or unbuffered danger trees in Riparian Zones.

Wind-throw amendments

In many of the wind-thrown edges, retaining standing trees to function as a wind break may be desirable to prevent further blowdown. The logging plan for the windthrow amendment must reflect:

- The location of the yarding corridors
- The lay of the wind-thrown trees in relation to the direction of yarding
- The specific type of yarding equipment to be used; this is important because a grapple yarder system cannot fulfill the performance requirements of a drop line system
- Faller substitution of residual trees to allow for hazardous tree removal and establishment of corridors
- Widening of the corridor at the roadside
- Availability of backspars or tailhold stumps
- Appropriate deflection for the yarding system

Riparian management and reserve zones

The logging plan must include notations to allow for tailholds in reserve areas and skyline corridors through the reserve areas of the block where safe deflection is necessary. It may be necessary to map and field mark backspars or tailhold trees and provide a written description of how tree damage will be controlled. Danger trees within reach of a yarding line that passes through the Riparian Reserve Zone must be removed. It is important that planners include appropriate comments on the silviculture and logging plans.

Feathered edges

Many prescriptions require that the edges of Riparian Zones be selectively cut to reduce windthrow potential. The larger “trigger trees” and other merchantable timber are removed. To minimize hazards to the rigging crew from residual saplings and trees being yarded over, it is advisable to yard these trees in tree lengths. If the trees are bucked to log length, residual trees made hazardous by yarding activities must be removed before workers set chokers in the hazardous areas.

Trespass

It is important that each logging plan provide for the removal of over-the line danger trees within reach of the work areas. Each operation must have a formal internal reporting system between the fallers, supervisors, and forestry engineers.

Forest engineering staff must in turn establish formal approval procedures for removal of over-the-line danger trees not covered in the original logging plan. This notification process is extremely important in controlling hazards in areas such as Riparian Zones or Biodiversity Patches. Windthrow creates these hazard areas during the harvesting phase. The logging plan must also note trees felled for guyline stumps and guyline corridors. Remember to plan the work and work the plan.

Now try the quiz on the next page.

Determine Block or Slope Orientation, Soil Conditions, and Limitations—Self-Quiz

1. Which are the specific areas to be monitored for danger trees?
 - ☐ Riparian Management and Reserve Zones
 - ☐ Gully Management Zones and Wildlife Tree Patches
 - ☐ Areas adjacent to side and back lines
 - ☐ All of the above
2. Landings must be large enough to land two-thirds of the length of the average log being yarded.
 - ☐ True
 - ☐ False
3. Straight downhill yarding on steep slopes:
 - ☐ Is prohibited.
 - ☐ Should be limited to slopes upon which there is no significant hazard to the rigging crews.
4. Riparian and Gully Management areas in which the edges have not been feathered significantly increase windthrow hazards.
 - ☐ True
 - ☐ False



Now check your answers on the next page.

Determine Block or Slope Orientation, Soil Conditions, and Limitations—Quiz Answers

5. Which are the specific areas to be monitored for danger trees?

Answer: **All of the above**

6. Landings must be large enough to land two-thirds of the length of the average log being yarded.

Answer: **True**

7. Straight downhill yarding on steep slopes:

Answer: **Is prohibited**

8. Riparian and Gully Management areas in which the edges have not been feathered significantly increase windthrow hazards.

Answer: **True**

Key Point 1.5: Develop a Grapple Yarder Site in Partnership with the Hook Tender

Engineering and layout considerations

A good logging plan, developed by competent engineering and production staff, permits the various operations to proceed safely, effectively, and efficiently. A good falling plan must be included. This plan will include removing danger trees and saplings and altering cutlines to avoid natural obstacles on the worksite. A good falling plan complements grapple yarding and loading operations. Remember to plan the work and work the plan.

When grapple yarding sites are planned, two basic operating rules of grapple yarding must be remembered:

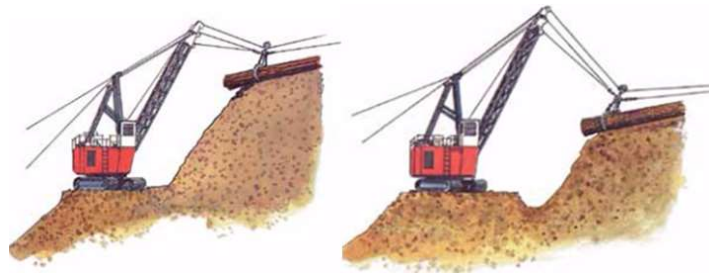
- Maximize the operator's vision of the felled and bucked timber
- Maintain sufficient deflection so that the grapple and lines remain suspended and the grapple opens and closes easily

Primary safety considerations must be based on these basic operating rules. Safety and production is enhanced when the following are part of the grapple yarding plan:

- Never yard straight downhill onto the machine
- A suitable log landing area must be selected in which logs can be landed and/or windrowed
- Provide adequate room for loading trucks and upgrading logs

Haul road layout and construction

The effectiveness of the logging plan will be determined by the location and construction of the haul roads. The location of the haul road determines the yarding distances.



Improper road location

Proper road location

Here are five common errors found in haul road layout and construction:

- Road is located too close to the natural slope
- Narrow road does not have a proper sub-grade bench
- Roads dead-end before the operator sees the yarding quarter
- Steel spar setting does not accommodate grapple yarding
- Grades are excessive

Road is located too close to the natural slope

Build the road on the edge not close to the natural slope. This eliminates the log coming off the bank at cab level as well as the operator having to swing the logs to the side, blocking the roadway.

Narrow road does not have a proper sub-grade bench

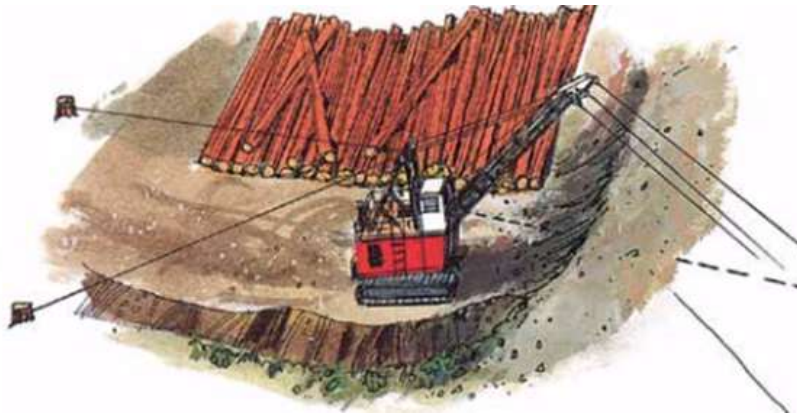
An alternative yarding method must be used when the width of the road and the bench of the sub-grade do not permit maintaining a clearance of 60 cm (2 ft.) between the counterweight of the yarder and any obstacle around it. A three-quarter bench is recommended for sub-grade. When the road is not sufficiently cut and ballasted during construction, there is a risk of the machine going over the bank because of road edge failure, or the complete grade might slough out.



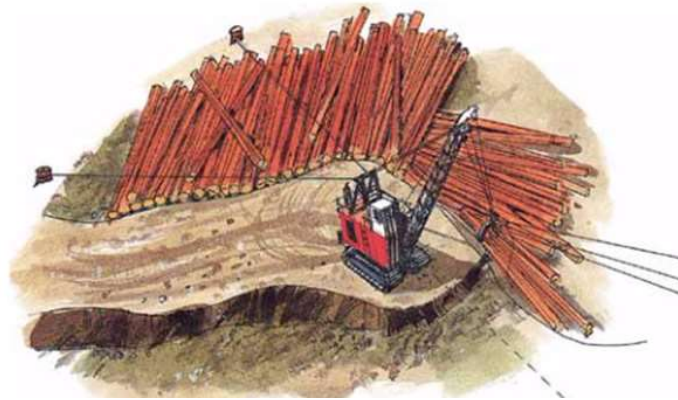
Narrow road without sub-grade bench

Roads dead-end before the operator sees the yarding quarter

Since grapple yarder operators should initiate most of the line movement, extend the spur road so the operator can see the felled and bucked timber.



Road ending where operator can't see logs



Operator can see felled and bucked timber

Grades are excessive

Grapple yarders are mobile and use the road as a continuous landing area. Because of their design, grapple yarders have limits to the angle at which they can be positioned.



Excessive grade

Refer to yarder manufacturer guidelines for recommendations on the grade angle. Exceeding the maximum recommended angle stresses the machine beyond its design and also affects the ergonomics of the operator's seat in relation to foot and hand controls.



If the hill is too steep the operator cannot keep control of the machine

Planning the back end

Planning the back end of a grapple yarding setting is as important to safety and productivity as the quality and location of the haul road. Planners must consider the various ways in which the back end can be rigged, examine the feasibility of rigging backspars, the necessity to stump-rig, and the use of a crawler tractor or hoe as a mobile backspar. Each setting will be different; the goal is to maintain deflection and reduce road change time.

If standing trees are to be used as backspars or if a lift tree is required, the falling crew must be notified so that they can adjust their falling plan accordingly. Trees should be selected and marked ahead of time to ensure that they are not felled and that no timber is felled behind them if they are located on the back line.

If a standing tree used as a backspar is located in the middle of a setting in which half of the logs will be yarded either way, it may be necessary to top the tree to prevent it from being blown down. The tree must be topped or appropriate work procedures provided if workers are going to be within reach of such a backspar or lift tree when the lines are moving during yarding operations. If the tree isn't topped and guyed, then workers are prohibited from being within 1 1/2 tree lengths when the lines are under load. The crew must have the necessary job skills to safely rig the tree. If those skills are not available in the crew, the use of a standing tree as a backspar must not be considered.

If a standing tree is to be used as an anchor, that tree must be secured to other trees or other anchors by a twister.

Suitable anchors

Many factors affect the suitability of a stump to withstand the stresses placed on it during yarding. Each species of tree has a different root system.

Factors that affect the root system are:

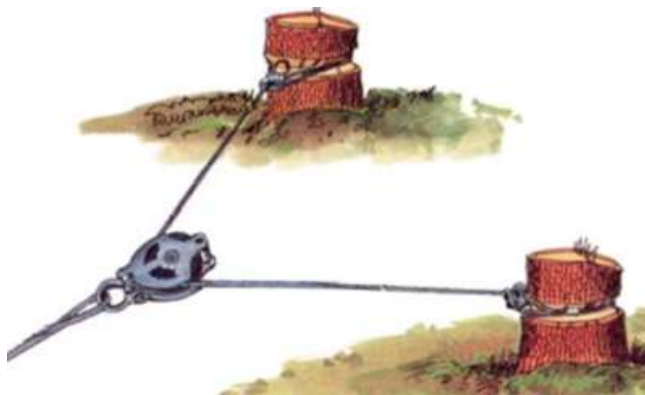
- Soil type
- Moisture
- Density
- Slope change

Predicting the holding power of a stump is difficult. Therefore, all stumps used as anchors must be inspected daily. A rule of thumb is to make a stump's holding power proportional to the square of the diameter; for example, an 80 cm (32 in.) stump is four times stronger than a 40 cm (16 in.) stump.

The holding power of a stump:

- Increases with soil depth
- Increases with soil density
- Is greater on an uphill pull
- Decreases as soil moisture increases

In the event that a single stump is not adequate, multiple stumps must be tied together and used. This could be a two-stump configuration where a bridle block is used, or it could be several stumps tied together.

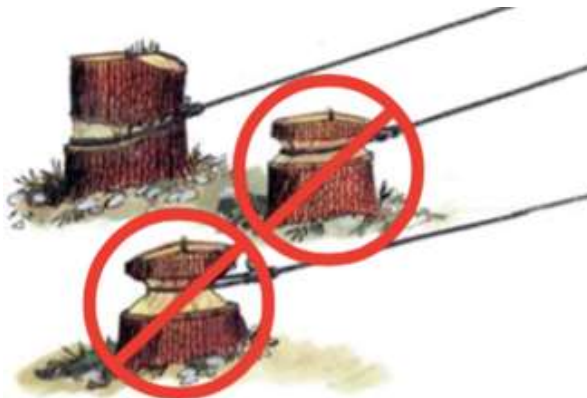


Bridle block

Notching of stumps

Stumps must be notched to hold the guyline. To prevent slabbing, the notch should be placed as close to the bottom of the stump as possible without cutting off the roots, and in lead with the guyline.

The picture below shows the top stump properly notched. The picture also shows the notch in the middle stump placed too high and the notch in the bottom stump, too deep.



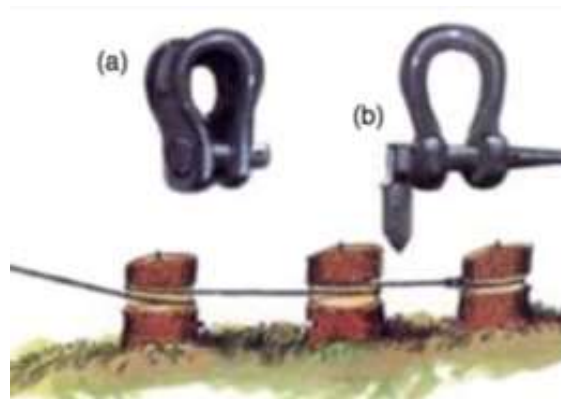
Securing of stumps

When there is doubt about a stump's dependability, use one or more of the following methods to increase stability and holding power:

- Multiple stump anchors
- Twisters
- Jill-poke supports
- Deadweight anchors

Multiple stump anchors

When a single stump is not available or is inadequate, it is acceptable to use multiple stump anchors such as a "wrap and choke." Guylines or skylines must be anchored to stumps with acceptable devices such as flat or bell shackles. Pins must be secured with Molly Hogans or other effective devices.

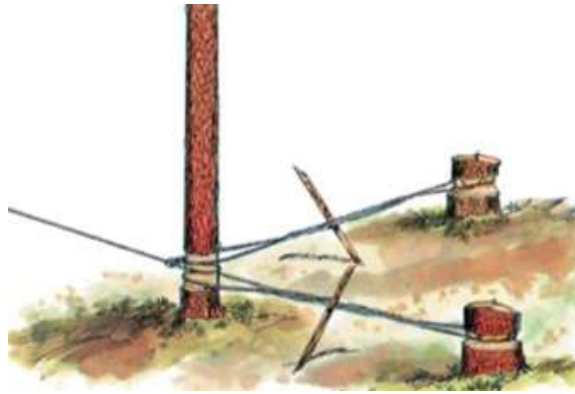


Acceptable multiple stump anchors (a) flat shackle, (b) bell shackle

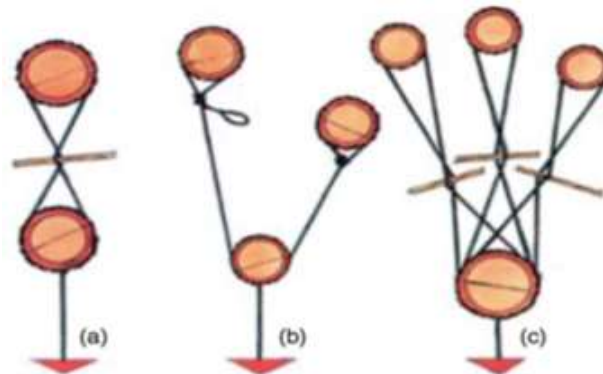
Twisters

Remember the following points when securing stumps with twisters:

- Ensure that a worker check system is used when only one worker is available to install twisters
- If two people do up twister, then two people need to undo it
- Select suitable anchors in lead with the pull
- Select suitable line for the twisters
- Notch secondary anchors to prevent line slippage
- Select a good, sturdy, green limb or sapling of sufficient length for the twister stick
- Install the twister with a minimum of two wraps with four lines connecting twister stump to original stump
- Secure with a timber hitch
- Use two poles if a long span requires more than one
- Tension lines so they will almost touch
- Place the twister pole between the lines
- Rotate the twister pole uphill until tight
- Secure the pole 90 degrees to the twister lines
- Unwrap a twister when removing it. Do not cut the pole to reduce tension



Twistlers on a standing tailhold



(a) Single twister, (b) two legs with cable clip, (c) multi-legged twister

Jill-poke supports

Follow these four steps when using jill-poke supports to secure stumps:

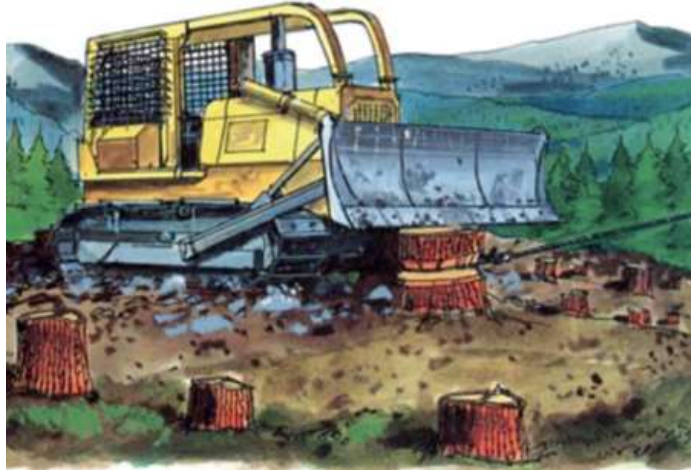
1. Select a suitable secondary anchor in front of and in lead with the anchor stump.
2. Cut a flat surface on each stump facing the other.
3. Cut a suitable log slightly longer than the distance between the two faces.
4. Drive the log into position between the anchors.



Jill-poke can replace a twister

Deadweight anchors

Mobile equipment can provide additional support for securing a stump by placing the blade or track on the stump or root system.



Bulldozer blade adds support to stump

Mobile machinery itself may be used as an anchor if it is of sufficient weight.

Skyline anchors

A skyline supplies lift for the rigging. With adequate deflection, the skyline need not be elevated at the back end. However, this method requires adequate anchor holding power and tiebacks. When deflection is minimal, skyline tailholds may be located well beyond the setting boundary. To acquire lift or deflection, backspars may be used. This method requires specialized rigging, climbing gear, and training.



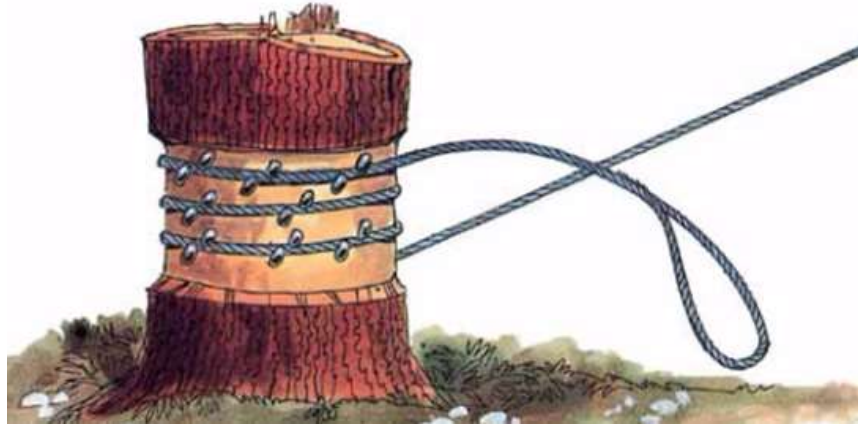
A wrap and a choke

Backspar guylines

When a backspar is required, guylines must be used. Proper rigging practices for guylines also apply to backspars. A come-along may be used to tighten a backspar guyline. Use a minimum of three spikes to secure the last wrap.

A guyline secured to a stump must be wrapped at least $2\frac{1}{2}$ times. The top wrap must be secured with three spikes. The number and position of spikes should be adequate to ensure that the guyline will handle the imposed stresses.

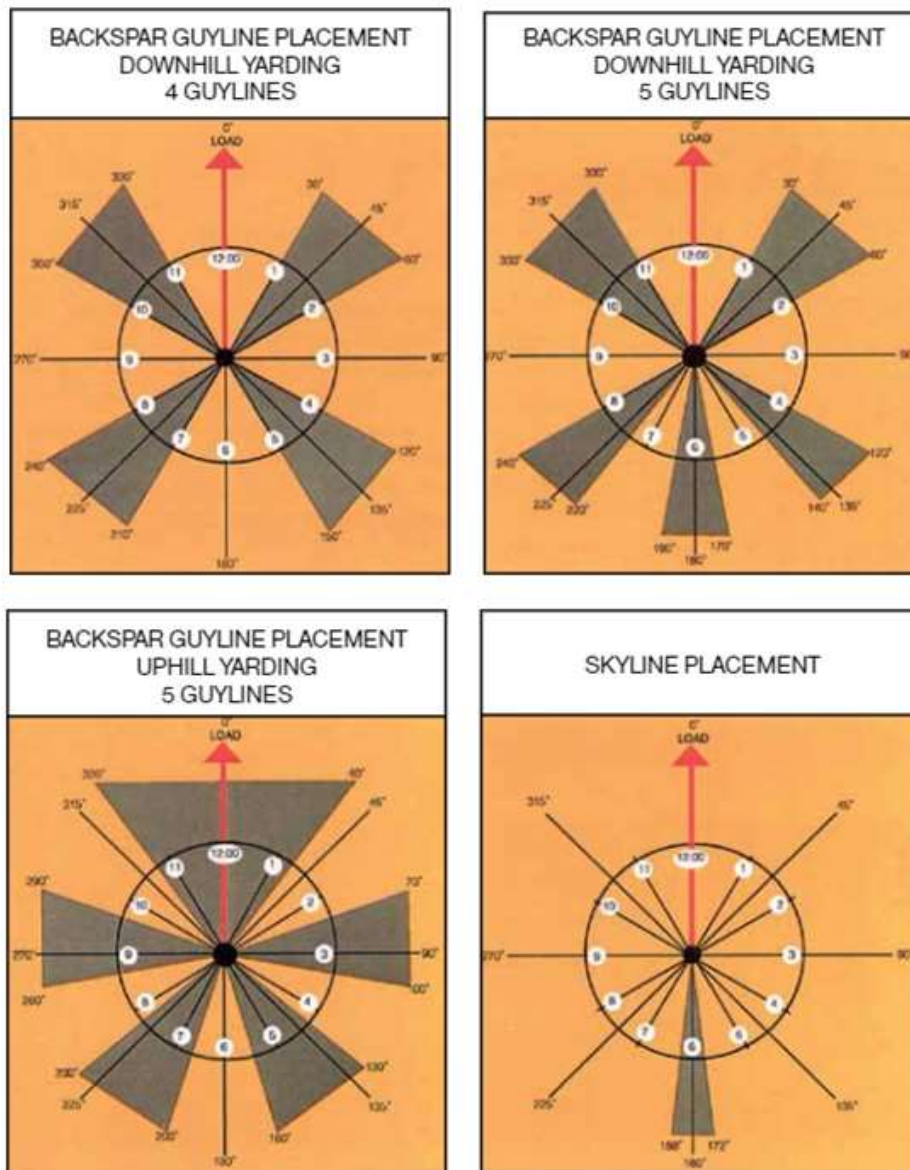
Railway spikes should only be used with large lines and large stumps.



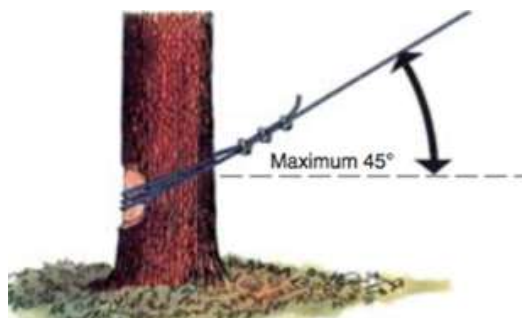
Home spar spiked guyline

Remember this rule of thumb: 2.5 cm (1 in.) of slack in the guyline on the stump gives 30 cm (1 ft.) of slack in the belly of the guyline.

The following diagrams show acceptable guyline and skyline placement patterns.



Cable clips are acceptable for securing lines. The line must have at least one full wrap on the stump. Ensure that the required number of clips are properly installed and torqued.



Backspar with cable clips

Tightening sequence

When yarding downhill from a backspar, the two front guylines must be tightened first. When yarding uphill, the two back guylines must be tightened first. Guylines should be tensioned to support the backspar adequately, and positioned so that the inside angle is less than 45 degrees to the horizontal. When this cannot be done, additional guyline support is required.

Now try the quiz on the next page.

Develop a Grapple Yarder Site in Partnership with the Hook Tender—Self-Quiz

1. The effectiveness of the logging plan will be determined by the location and construction of the haul roads.
☐ True
☐ False
2. If the crew doesn't have the necessary job skills to safely rig the tree, using of a standing tree as a backspar must not be considered.
☐ True
☐ False
3. A 80 cm (32 in.) stump is how many times stronger than a 40 cm (16 in.) stump?
☐ Two
☐ Three
☐ Four
☐ Six
4. The holding power of a stump is lower on an uphill pull.
☐ True
☐ False
5. When securing the stump with the twister, the twister with a minimum of two wraps must be installed.
☐ True
☐ False



Now check your answers on the next page.

Develop a Grapple Yarder Site in Partnership with the Hook Tender—Quiz Answers

1. The effectiveness of the logging plan will be determined by the location and construction of the haul roads.

Answer: **True**

2. If the crew doesn't have the necessary job skills to safely rig the tree, using of a standing tree as a backspar must not be considered.

Answer: **True**

3. A 80 cm (32 in.) stump is how many times stronger than a 40 cm (16 in.) stump?

Answer: **Four**

4. The holding power of a stump is lower on an uphill pull.

Answer: **False**

5. When securing the stump with the twister, the twister with a minimum of two wraps must be installed.

Answer: **True**

Key Point 1.6: Perform Pre-Start Equipment Checks

Pre-start inspection

The daily pre-start checklist runs as follows

- ☐ Engine oil level – Maintain oil level at full mark
 - ☐ Coolant – Maintain sufficient coolant level to cover the core inside of the radiator
 - ☐ Leakage – Always check under, and around, machine for telltale signs of fluid leakage
 - ☐ Fuel – Check level and TOP OFF tank, if needed, to assure day long operation
-



CAUTION!

Do not allow fuel tank to run dry.

- ☐ Fuel shut-off valve: This is located on bottom of tank. Make sure valve is in the open position. Do not mistake quick release drain cap for shut-off valve.
- ☐ Lubrication: Lubricate daily all points shown on lubrication chart, including all mounting bushings and pins.
- ☐ Hydraulic system: Visually inspect valves, pumps, motors, connections, mounting bushings, pins, reservoir sight gauge, and oil temperature gauge. Check hydraulic rams for leaks where ram exits the cylinder.
- ☐ Fuel filters: Drain accumulated water and sediment from the water trap filters daily.
- ☐ General condition: Perform overall visual check for damage, wear, leaks, and cleanliness. After daily check is complete and systems checked, you may start your engine.
- ☐ Vandalism: Look for evidence of vandalism, tampering, unfinished repair work, or loose tools. Inspect control panels for obvious disconnects.
- ☐ Air oiler: Check airline lubricator oil level.
- ☐ Gear train: Check yarder gear train for adequate lubrication.

- ☐ Air tank: Drain water from wet air tank.
- ☐ Operator controls: Place all operator controls in neutral or off positions, with brakes in set position.
- ☐ Battery: Turn battery master switch on.

Now try the quiz on the next page.

Perform Pre-Start Equipment Checks—Self-Quiz

1. What should never run dry?

- ☐ Fuel tank
- ☐ Pumps
- ☐ Air Tank
- ☐ Fuel Valve

2. All operator controls should be in their neutral or off positions, with all brakes in set position.

- ☐ True
- ☐ False



Now check your answers on the next page.

Perform Pre-Start Equipment Checks—Quiz Answers

1. What should never run dry?

Answer: **Fuel tank**

2. All operator controls should be in their neutral or off positions, with all brakes in set position.

Answer: **True**

Key Point 1.7: Perform Start-Up Procedures

Starting the engine

Note: After completing the daily pre-start checks, the yarder engine may be started and warmed up as follows:

Engine start-up

To start the engine, complete the following steps:

1. Place transmission shift selector in neutral.
2. Advance throttle control level slightly above slow idle position.
3. Turn the key ignition switch clockwise to start position and hold.
Release ignition switch when engine starts.
 - If engine stalls, allow engine to stop revolving before trying to restart.
 - If engine fails to start within a 30 second period, allow starter to cool at least two minutes before trying to start engine again.



CAUTION!

Do not try to operate machine until all pressures and temperatures have reached recommended levels.

4. Immediately after the engine starts, observe the engine oil pressure gauge.
 - If no oil pressure is indicated within 10-15 seconds, shut the engine down and inspect the lubrication system levels and connections. Refer to engine manual for troubleshooting.
5. Run the engine at idle speed for approximately five minutes. This will allow air and oil pressures and engine temperatures to build up to operating levels.

Note: Check the engine and yarder for air or oil leaks; repair any leaks before attempting to operate yarder.

Jump starting the engine



CAUTION!

Always have ignition key in off position before connecting cables and transmission in the neutral position before connecting cables.

The ground cable must be attached last and removed first to prevent sparks from occurring near the battery. Sparks could cause battery vapors to explode.

Attach the ground cable from the booster battery to a point away from and below the battery. Use starter ground post of machine to be started.

To prevent possible personal injury, care must be used when removing the cables from the machine that has been started. Do not allow the cable ends to contact each other or the machine.

Reminder before jump starting the engine:

- Always connect batteries in parallel: positive to positive, negative to negative.
 - Connect positive poles first, negative poles second.
 - Disconnect negative poles first, positive poles second.
1. Attach one cable to ungrounded POSITIVE (+) terminal of battery on machine to be started.
 2. Attach opposite end of cable to POSITIVE (+) terminal of external starting source.
 3. Attach second cable to NEGATIVE (-) terminal of starting source.
 4. Attach remaining cable end to the starter post of the machine to be started.
 5. Start engine.
 6. After engine starts, remove cable end from starter ground post of machine just started then remove opposite end of cable from negative terminal of starting source.
 7. Remove cable from POSITIVE (+) terminal of battery on machine started.
 8. Remove opposite end of cable from POSITIVE (+) terminal of starting source.

Warming up the machine

Recommended warm-up procedure

After machine has started, allow adequate time for oils to warm to operating temperature. Machine warm up is part of daily preventative maintenance. For smooth response and accurate movement, all oils must flow freely. Warm oils flow freely.

Make it a daily habit to allow engine to idle at about 550 RPM for a period of 3-5 minutes.

Now try the quiz on the next page.

Perform Start Up Procedures—Self-Quiz

1. If the engine fails to start within a 30 second period, you must allow the starter to cool at least two minutes before trying to start engine again.
☐ True
☐ False
2. The operator must run the engine at idle speed for approximately five minutes to allow air and oil pressures and engine temperatures to build up to operating levels.
☐ True
☐ False
3. The operator must connect the positive poles first, then the negative poles, then to disconnect, positive poles first, negative poles second.
☐ True
☐ False
4. It is recommended to allow the engine to idle at about 550 RPM for a period of 3 to 5 minutes.
☐ True
☐ False



Now check your answers on the next page.

Perform Start Up Procedures—Quiz Answers

1. If the engine fails to start within a 30 second period, you must allow the starter to cool at least two minutes before trying to start engine again.

Answer: **True**

2. The operator must run the engine at idle speed for approximately five minutes to allow air and oil pressures and engine temperatures to build up to operating levels.

Answer: **True**

3. The operator must connect the positive poles first, then the negative poles, then to disconnect, positive poles first, negative poles second.

Answer: **False**

4. It is recommended to allow the engine to idle at about 550 RPM for a period of 3 to 5 minutes.

Answer: **True**

Key Point 1.8: Ensure that Signaling Devices on a Grapple Yarder are Working Properly in Accordance with Regulation

Radios and verbal signals

VHF radio whistles and UHF grapple yarder radio equipment

To ensure that radio equipment used to replace hand signals provides reliable, non-ambiguous, uninterrupted signals, the radio equipment must meet the current WorkSafeBC requirements.

WorkSafeBC officers inspecting workplaces where grapple yarders are used ensure the following:

All necessary documentation must be available at the workplace, either in an office located on the workplace or in the grapple yarder, including:

1. Industry Canada radio license for the current year. Licenses expire on April 1 of each year.
2. Confirmation letter from WorkSafeBC, which states the following:
 - Company name
 - Address
 - Division
 - Contact person
 - Geographical coordinates
 - Area name
 - Assigned frequency and tones
 - Manufacturer and model of radios
 - Company radio identifier
 - Coordinating agency radio code and number
 - Transmitter power output

If this documentation is not available or is out of date, the officer will issue an order requiring the frequency to be licensed and coordinated. Transmitters must be removed from service until they are licensed and coordinated.

3. Radio signaling devices, either hand-held transmitters or equipment-mounted radios used in logging operations, must be clearly marked with the following:

- Name of the manufacturer
- Serial number
- Assigned operating frequency
- Specified tone frequency

4. Radio signaling devices must have the following:

- Power limits of $\frac{1}{4}$ watt for grapple yarder radios
- Power limits of $\frac{1}{2}$ watt for high-lead radio whistles
- Permanently enabled tone-encoded squelch

There should only be one frequency per radio. Where multichannel radios are used, the selection switch shall be disabled so that only an authorized person can change the operating

Interference on radio frequencies

Radio signals replace audible signals for the movement of equipment in logging. Interference by other radios on the same frequency can seriously endanger workers.

Ensure that Signaling Devices on a Grapple Yarder are Working Properly in Accordance with Regulation—Self-Quiz

1. How long is a radio license current for and when is it to be renewed?
 - ☐ 1 year and every March 1st
 - ☐ 1 year and every April 1st
 - ☐ 2 years and every March 1st
 - ☐ 2 years and every April 1st
2. Grapple yarders can move into new areas and commence work without registering radio frequencies.
 - ☐ True
 - ☐ False
3. What wattage are grapple yarder radios limited to?
 - ☐ 2 watt
 - ☐ 1 watt
 - ☐ ½ watt
 - ☐ ¼ watt
4. What do you do if you encounter another crew using your same channel?
 - ☐ Continue work
 - ☐ Stop work and report it to your supervisor
 - ☐ Stop work and report it to WorksafeBC frequency coordinator
 - ☐ Number 2 and 3



Now check your answers on the next page.

Ensure that Signaling Devices on a Grapple Yarder are Working Properly in Accordance with Regulation— Quiz Answers

1. How long is a radio license current for and when is it to be renewed?

Answer: **1 year and every April 1st**

2. Grapple yarders can move into new areas and commence work without registering radio frequencies.

Answer: **False**

3. What wattage are grapple yarder radios limited to?

Answer: **¼ watt**

4. What do you do if you encounter another crew using your same channel?

Answer: **Number 2 and 3**

Section 1021-02: Operate Grapple Yarder

What you need to know about this section

By the end of this section, you will be able to demonstrate your knowledge and ability in the following key points:

2.1 Operate grapple yarder in accordance with block requirements and Manufacturer's specifications

2.2 Yard logs/ pile logs in accordance with block requirements and Manufacturer's specifications

2.3 Change roads in accordance with block requirements and Manufacturer's specifications

2.4 Operate grapple yarder smoothly in accordance with block requirements and Manufacturer's specifications

2.5 Spool lines

2.6 Run guylines

2.7 Move grapple yarder safely within block

2.8 Operate safely with other equipment and workers in the landing

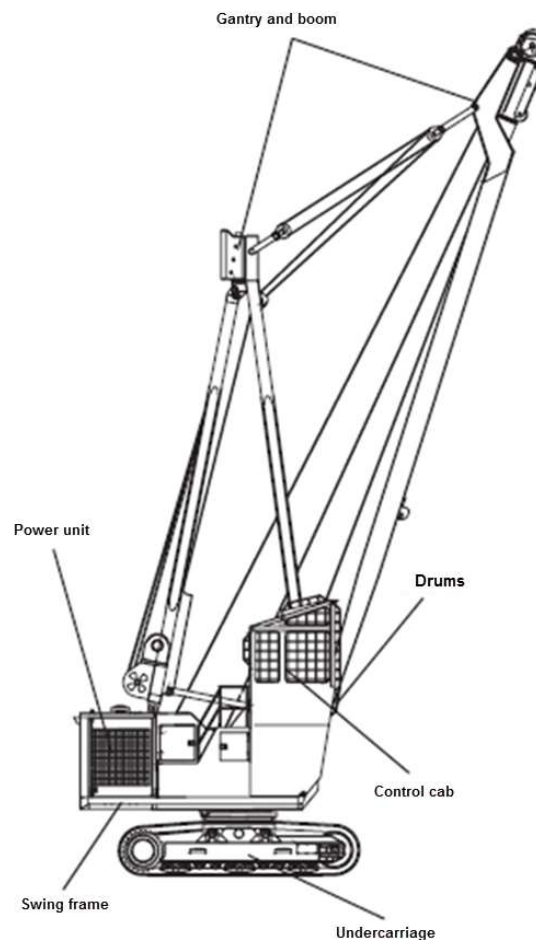
2.9 Monitor performance of equipment during operation

Key Point 2.1: Operate Grapple Yarder in Accordance with Block Requirements and Manufacturer's Specifications

There are different kind of grapple yarders manufactured by different companies so it is very important to refer to the manufacturer's specifications and manuals for each specific machine.

This key point present **general machine specifications and descriptions** for your reference.

Grapple yarder component descriptions



Swing frame

Entire upper portion of machine. Includes:

- Cab
- Drum arrangement
- Power unit
- Hydraulics
- Fuel tanks

Undercarriage

That portion of the machine below the carrier frame including the track frames, drive motors, etc.

Control cab

That portion of the machine where the operator controls the operation of the machine.

Tower and mast

That portion of the machine above the swing frame. Includes:

- Tower
- Mast assembly
- Fairlead assemblies
- Guyline drum assembly

Power unit

The power unit is located in the rear portion of the swing frame and includes:

- Engine
- Transmission
- Air compressor
- Radiator
- Travel pumps
- Pump drive

Drum arrangement

That portion of the machine located in the middle of the swing frame, which includes:

- Haulback
- Front main and rear main drums
- Chain case
- Drive shaft
- Brake band installation

Track drive

That portion of the undercarriage which provides the travel.

Guyline drums

That portion of the tower which controls the tension of the guylines.

Swing bearing

Center bearing which enables the swing frame and undercarriage to rotate independently of one another.

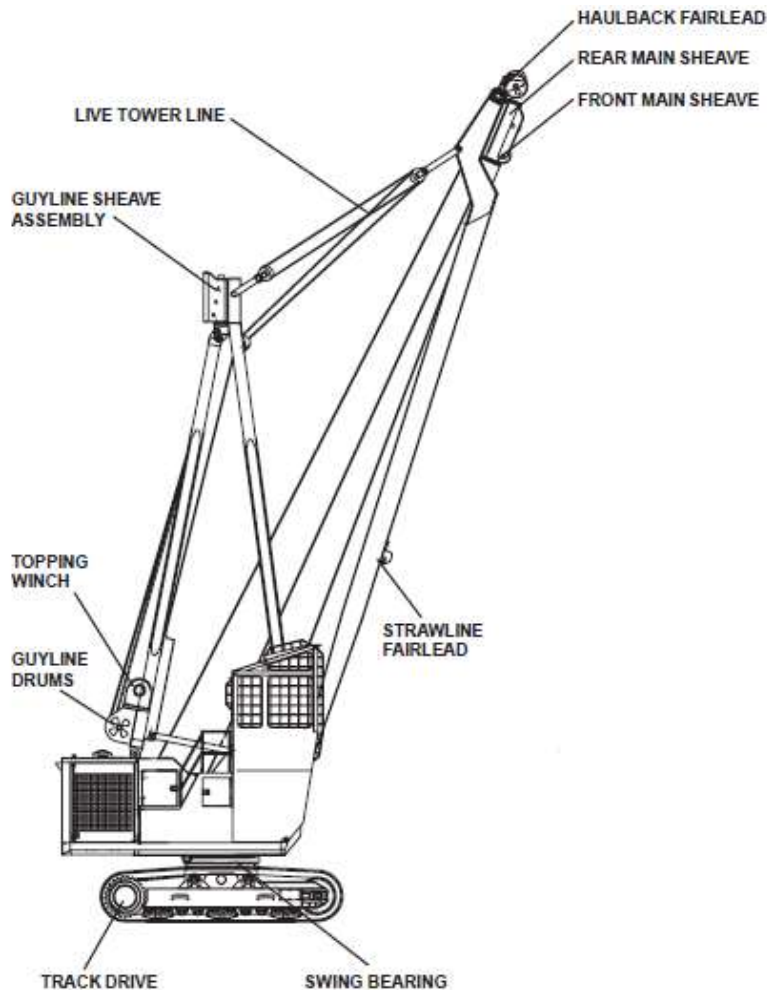
Topping winch

Hydraulically-driven drum for raising and lowering the tower, with spring set air release dogs for positive lock.

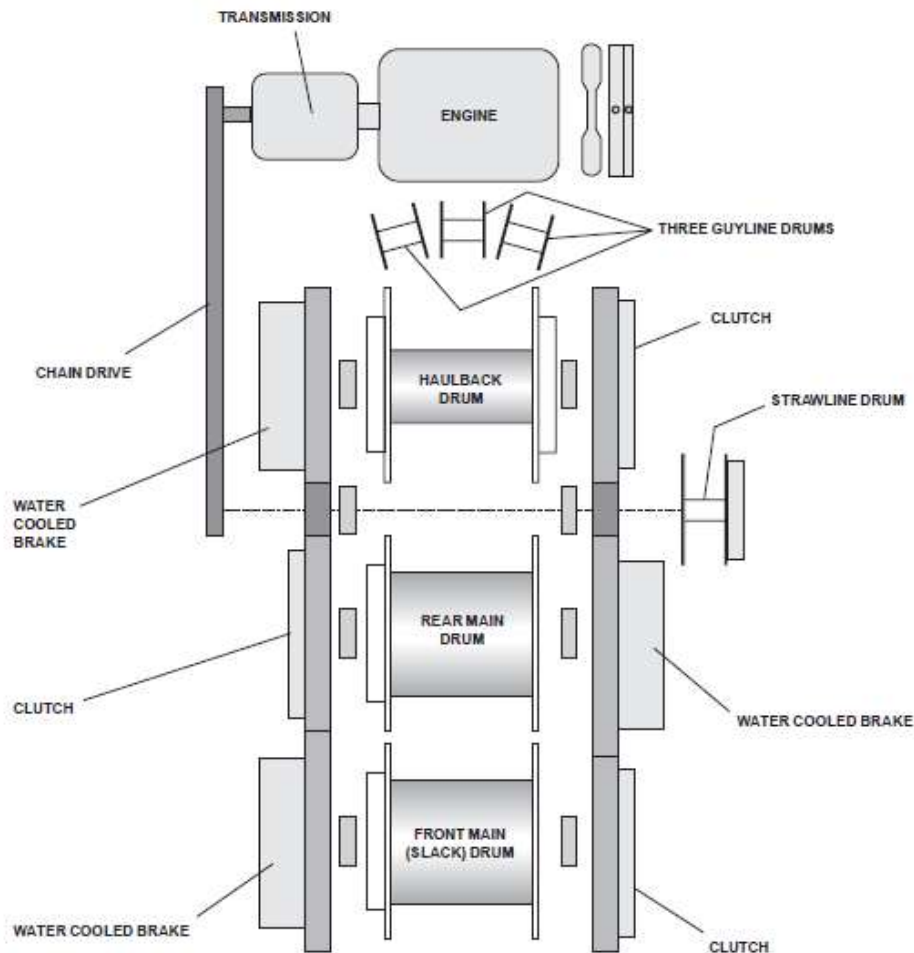
Fairlead assemblies

That portion of the tower which enables the operations cables to change work angles. Each work line has its own fairlead or sheave:

- Haulback
- Front main
- Rear main
- Strawline
- Guylines



Power train formation



Power: The engine provides adequate power to drive the power train drum requirements and two hydraulic pumps through a two-station pump drive transmission for continuous operation. The pumps provide power for the travel functions.

Traction hydraulic system: The system is made up of one variable-displacement over-center piston pump for each track.

Crawler: The crawler assembly consists of the following:

- Crawler frames
- Drive sprockets
- Idler mechanism
- Track rollers
- Drive units

Swing frame: The assembled carrier frame includes:

- Power unit
- Control cab
- Guarding
- Drum arrangement

Formed, steel panels, bolted to the upper frame and support posts, shroud the engine, radiator and hydraulic pumps.

Lockable doors provide easy access to the engine house. The operator's cab is shock mounted and lined with 1" thick, closed-cell foam latex for temperature insulation and noise reduction. The front and rear windows are fixed. The right hand side window slides open to allow adequate ventilation. The hinged door locks in the open position.

Drum arrangement: Fabricated box-type structure, line bored pedestals for accurate gear alignment, with gears, clutches and water-cooled brakes mounted outboard for ease of maintenance.

Tower and mast: The live tower is a fabricated (hi-tensile) steel A-frame, lattice style structure with a normal working height of 60', complete with swivel type fairleads. The haulback sheave is 20" diameter, the main is 16" diameter, and the slack puller is 13" diameter, all mounted on tapered roller bearings.

The mast and back support are tube frame structures with a 43' working height with three swivel, walkover type guy line fairleads. The guyline mast is designed so that it is free to swivel about the center of machine rotation during swing operation.

The mast is supported at the rear by an A-frame backstay, which in turn is pinned to the swing frame. The backstay is provided with a stiffener between the mast foot and the backstay foot. This stiffener also acts as a lifting arm during tower and mast erection.

Drive input housing: Power is provided from the transmission to the drive input housing. The primary reduction from the transmission is a sprocket and chain drive to the drive shaft. The primary chain reduction is mounted on the end of the drive shaft.

Drive shaft: The drive shaft first provides power through a pinion gear to the drum gears. The shaft extends on across the drum frame to drive the straw drum.

Straw drum: The straw drum is mounted on the end of the drive shaft and is located directly in front of the power unit on the left side of the machine. It is driven by an air-operated plate clutch keyed to the drive shaft, with the drum mounted on roller bearings for freewheeling.

The drum is fitted with a large disc brake and is also spring set for parking or emergency use. The straw drum is under wound during inhaul.

Main drums: Power is provided to either drum by means of gears (with clutches) located outside of main frame. Dropline functions are powered by means of reversing gears (with clutches) located inside of main frame. (Optional) Pull clutches are hydraulic operated, located outside of main frame.

Haulback drum: The haul back drum is keyed to the shaft, with the shaft mounted on roller bearings. The drum is driven by a operated internal expanding clutch, which is keyed to the shaft. The shaft has

an Eaton 224 water cooled tension brake, keyed to the shaft, located outboard of the yarder frame on the power unit side. In addition, the drum is fitted with a two piece, air-operated band brake, which is also spring set for parking emergency use.

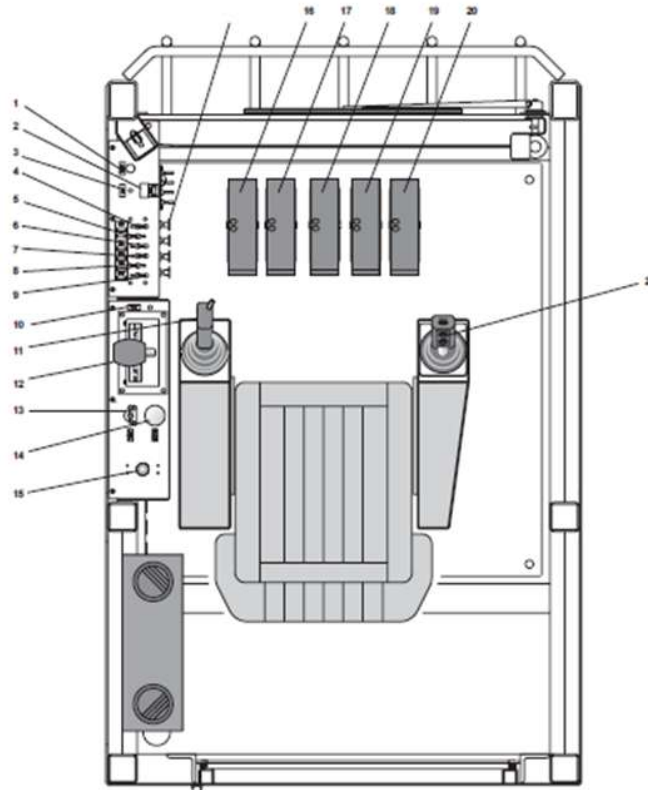
Guyline drum: The guyline drums are mounted on the tower assembly, welded to the backstay frame. The guy line drums are bushing mounted on a common stationary mount. Each drum is driven by a hydraulic drive motor, driving through a double chain reduction. In addition, each drum has a spring-on, air-off locking dog. All controls are mounted in the operator's cab.

Swing drive: Planetary drive with a radial-piston style hydraulic motor and spring-set, hydraulically-released brake; provides swing torque to a large diameter slewing ring.

Control Cab: Rear entrance cab, mounted on the right hand side of the frame, positioned forward to observe landing and operation of machine at all times. This comes equipped with all yarding controls, as well as the following:

- Wiper
- Heater
- Defroster
- Insulation
- Tinted windows
- Escape hatch
- Widescreen window guards
- Tube-type front log guard

Operator cab – controls and instruments



ITEM	DESCRIPTION
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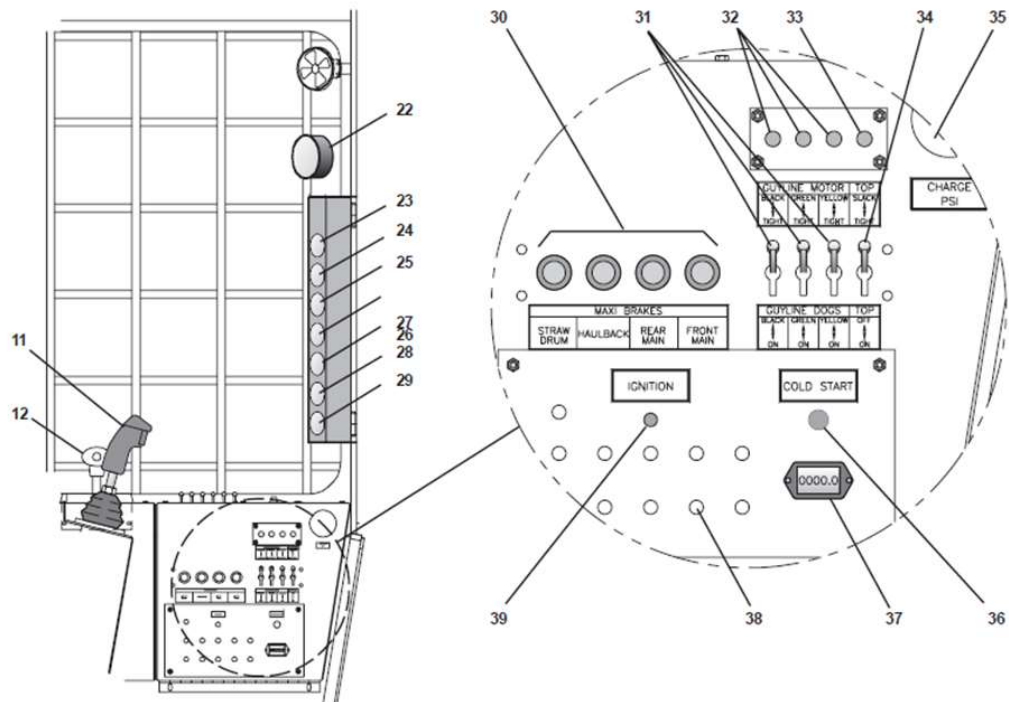
- | | |
|----|---|
| 1 | Warning Light |
| 2 | Travel Hi/Low Control |
| 3 | Wiper Control |
| 4 | Swing Brake On/Off Control |
| 5 | Yard/Travel Control |
| 6 | Main On/Off Control (Rear Main Drum) |
| 7 | Slack On/Off Control (Front Main Drum) |
| 8 | House Lock On/Off Control |
| 9 | Servide Brake On/Off Control |
| 10 | Do Not Shift Indicator |
| 11 | Swing and Throttle Control |
| 12 | Transmission Range Selector Control |
| 13 | Straw Drum Clutch control |
| 14 | Strawdrum Brake Air Pressure Gauge |
| 15 | Strawdrum Brake Control |
| 16 | Left Travel Brake Control |
| 17 | Haulback Drum Brake Control |
| 18 | Slackpulling Drum Brake Control (Front Main Drum) |
| 19 | Main Drum Brake Control (Rear Main Drum) |
| 20 | Right Travel Brake Control |

ITEM	DESCRIPTION
------	-------------

- | | |
|----|---------------------------------------|
| 21 | Drum Control (All) |
| 22 | Gauge, Interlock Air Pressure |
| 23 | Gauge, Water Cooled Brake Temperature |
| 24 | Gauge, Engine Oil Pressure |
| 25 | Gauge, Engine water Temperature |
| 26 | Gauge, Transmission Oil Pressure |
| 27 | Gauge, Transmission Oil Pressure |
| 28 | Gauge, Voltmeter |
| 29 | Gauge, System Air Pressure |
| 30 | Maxi Brakes (All Drums) |
| 31 | Guyline Drum Dog Controls |
| 32 | Guyline Drum Motor Controls |
| 33 | Topping Drum Motor Control |
| 34 | Topping Drum Dog Control |
| 35 | Gauge, Charge Pressure |
| 36 | Cold Start Control |
| 37 | Gauge, Hour Meter |
| 38 | Fuse Panel |
| 39 | Ignition Switch |

ITEM	DESCRIPTION
1	Warning Light
2	Travel Hi/Low Control
3	Wiper Control
4	Swing Brake On/Off Control
5	Yard/Travel Control
6	Main On/Off Control (Rear Main Drum)
7	Slack On/Off Control (Front Main Drum)
8	House Lock On/Off Control
9	Serve Brake On/Off Control
10	Do Not Shift Indicator
11	Swing and Throttle Control
12	Transmission Range Selector Control
13	Straw Drum Clutch control
14	Strawdrum Brake Air Pressure Gauge
15	Strawdrum Brake Control
16	Left Travel Brake Control
17	Haulback Drum Brake Control
18	Slackpulling Drum Brake Control (Front Main Drum)
19	Main Drum Brake Control (Rear Main Drum)
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ITEM	DESCRIPTION
21	Drum Control (All)
22	Gauge, Interlock Air Pressure
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24	Gauge, Engine Oil Pressure
25	Gauge, Engine water Temperature
26	Gauge, Transmission Oil Pressure
27	Gauge, Transmission Oil Pressure
28	Gauge, Voltmeter
29	Gauge, System Air Pressure
30	Maxi Brakes (All Drums)
31	Guyline Drum Dog Controls
32	Guyline Drum Motor Controls
33	Topping Drum Motor Control
34	Topping Drum Dog Control
35	Gauge, Charge Pressure
36	Cold Start Control
37	Gauge, Hour Meter
38	Fuse Panel
39	Ignition Switch



Now try the quiz on the next page.

Operate Grapple Yarder in Accordance with Block Requirements and Manufacturer's Specifications—Self-Quiz

1. In the operator's cab, the brake pedals are located on the floor.
☐ True
☐ False
2. The main drums are supplied power by hydraulics.
☐ True
☐ False
3. The guy-line drums can only be run from the cab.
☐ True
☐ False



Now check your answers on the next page.

Operate Grapple Yarder in Accordance with Block Requirements and Manufacturer's Specifications—Quiz Answers

1. In the operator's cab, the brake pedals are located on the floor.

Answer: **True**

2. The main drums are supplied power by hydraulics.

Answer: **False**

3. The guy-line drums can only be run from the cab.

Answer: **False**

Key Point 2.2: Yard Logs or Pile Logs in Accordance with Block Requirements and Manufacturer's Specifications

Yarding the logs

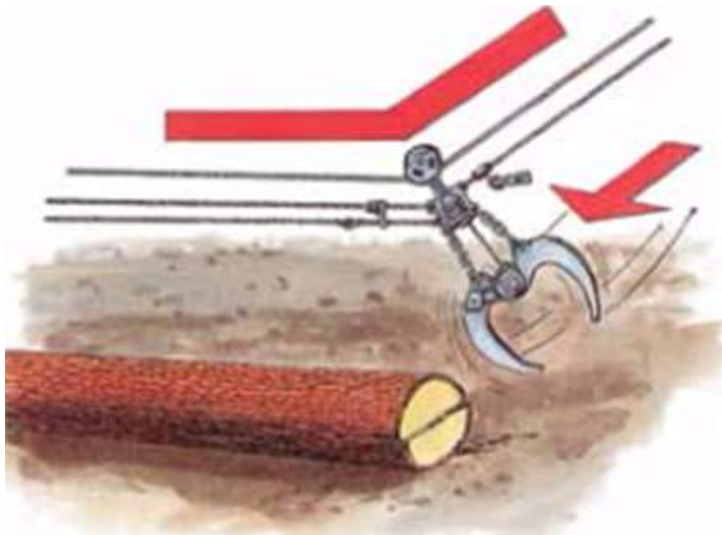
The logs lying where the pile will be built must be straightened out before other logs are piled on top. This is most important in steep ground landings where several roads will be yarded before the yarder is moved. After straightening out the bottom logs the operator continues to yard all the logs that can be seen. While the operator is yarding the first few turns, the hook tender and backspar operator conduct an inspection of the rig-up.

The following items are checked in this inspection:

- The mobile backspar, backspar tree, or stumps are stable
- All lines are free of sidebinds and wraps, and are running clear in the block
- The guylines have remained in the notches, and the tailhold stumps are secure
- The yarder has maintained the 60 cm (2 ft.) counterweight clearance
- The strawline end has been secured to the back stop
- The mainline and the haulback are spooling properly

Spotting the grapple

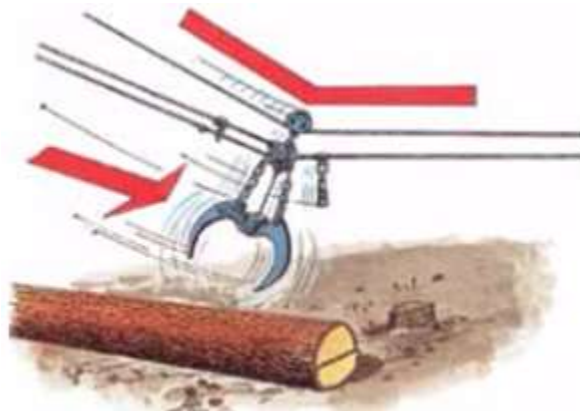
Once the operator has yarded all these logs, the spotter or utility worker then walks the yarding road to spot or guide the grapple onto the remaining logs. Hand signals must not be used; because of distance and limited visibility, all communications must be verbal.



Slacking the haulback



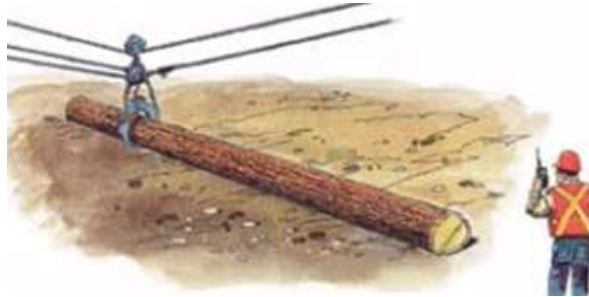
Stand in a safe position when talking a grapple onto a log



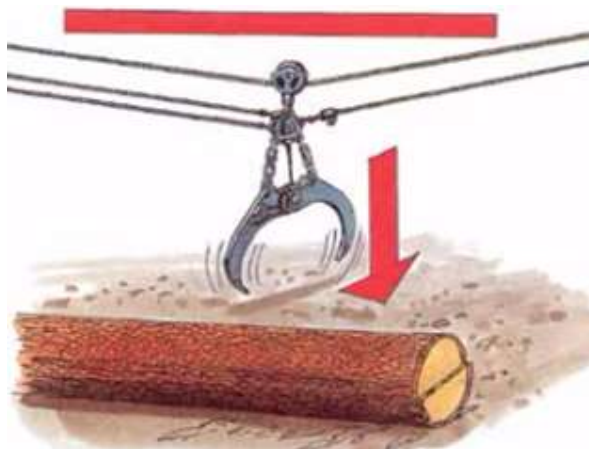
Slacking mainline

The movement of the grapple is no different than any other load suspended from two points. When you slack the front end (the mainline), the grapple travels toward the tailhold. When you slack the

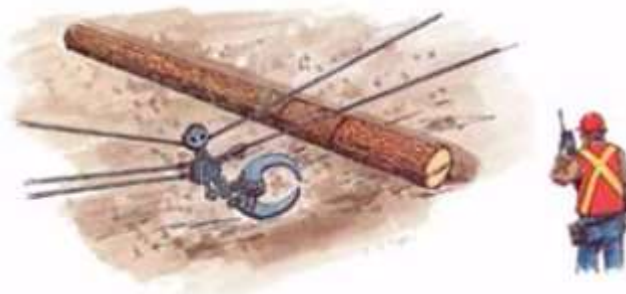
back end point of suspension (the haulback), the grapple moves toward the yarder. When both lines are slackened at the same rate, the grapple drops almost straight down. The distance that the grapple moves forward or back depends on how high it is suspended above the log. Often the grapple will rotate and miss the log as it is being slacked down. When the grapple misses the log, the spotter asks the operator to tightline. The spotter waits until the grapple is over the log and then requests slack.



Grapple tightened back on log



Both lines are slackened



Grapple missed log

Standing in the clear

Before giving the go-ahead signal, the spotter must ensure that he is well in the clear. "In the clear" means to be above and behind the log and grapple. Particular attention must be given to the hazard of the haulback side whip. When yarding uphill, the spotter must always walk far enough across the sidehill to be clear of any logs and chunks that may be dislodged by the turn.



In the clear as turn moves to landing

The use of standardized verbal commands

Crew will press the transmit button to tell the operator to start slowing down. It makes it easier to get the grapple on a log in a safe and timely manner.

To instruct operator to	Signaller says
Grapple log and go ahead	CLOSE AND GO
Close grapple but not go ahead	CLOSE
Stop rigging	STOP
Open grapple	OPEN
Move empty grapple ahead	AHEAD
Move empty grapple back	BACK
Go ahead on strawline	AHEAD ON THE STRAWLINE
Slack mainline	MAINLINE
Slack haulback	HAULBACK
Lower grapple	DOWN

Slack strawline	SLACK STRAWLINE
Swing to operator's left	SWING LEFT
Swing to operator's right	SWING RIGHT
Hold haulback and go ahead on mainline	TIGHTLINE

If at all possible, give the operator notice of what you want ahead of time. Have second or third log to go for if you miss the first one.

Standard high lead signals are used when setting chokers off the grapple yarder. The hooker or spotter just converts them to voice commands. For example, tell the operator “go ahead” when the choker is set, you’re in the clear, and you want the operator to go ahead on the turn.

Working the draws and ridges

The hook tender must move the tailholds and yarder in lead with the draws and ridges in order to get the best visibility for the operator and the greatest line deflection. This reduces the need for spotting logs by radio and minimizes damage to the logs. The hazard of upending and swinging logs is reduced, enhancing safety and productivity. In areas where the tailhold machines cannot move far enough to get the correct lead, a crawler tractor with one dutchman block can be used. The length of the dutchman line can be adjusted to maintain the desired line deflection as yarding progresses toward the back end.



Crawler tractor with one Dutchman block

To reduce the danger of runaway logs on settings in which the uppermost part of the setting is very steep, the back end of the setting can be yarded uphill. This will ensure the safety of the landing crew and enable loading activity to continue. When the logs are landed, the operator must maintain the proper haulback tension to control the log. When yarding on flat ground or uphill, sufficient slack should be maintained on the haulback to enable the back end of the log to be dragged as it approaches the landing.

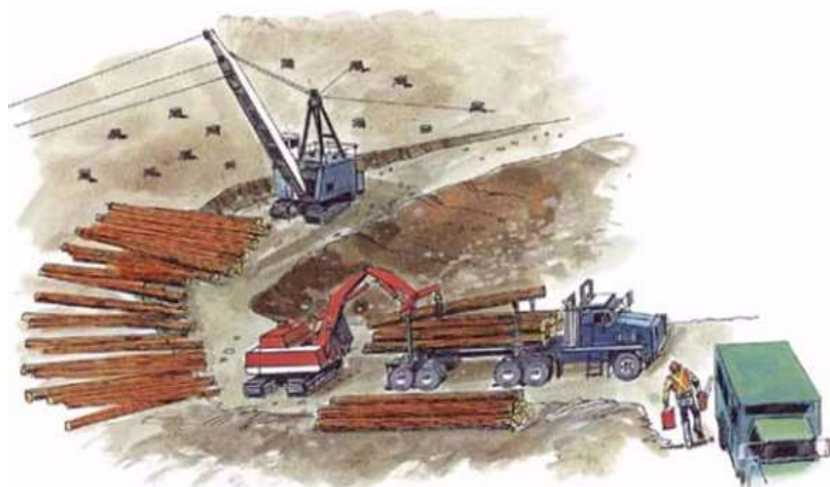


Splitting the logging setting by logging uphill and downhill

Machine operation

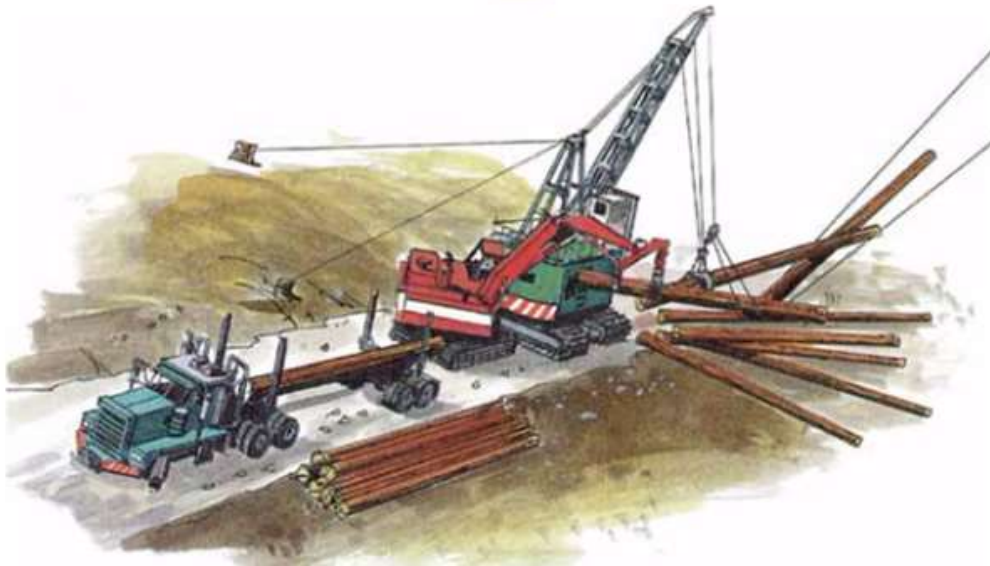
When the loader is loading from the active grapple yarder log pile, several precautions must be taken:

- Minimum 60 cm (2 ft.) clearance between loader counterweight and all obstructions such as log pile, banks, and other equipment must be maintained
- The landing worker and the chaser must stay out of the active log landing and loading area at all times
- Loader operators must avoid swinging the boom or snorkel into grapple yarder lines. Inadvertent movement of the lines when struck by a loader may result in injury to the hook tender or spotter, who may be setting a choker or spotting the grapple



A well-planned log landing

- On steep downhill yarding, the loading must not take place below the yarding road
- When loading from the high side, the log loader must be positioned so that logs will not slip out of the windrow pile and strike the log loader



Congested log landings are extremely hazardous for workers

- Good communications must exist between machine operators and ground crew
- To avoid swinging the loader under the lines to grab logs, the setting should be yarded from the front to the back. It is preferable to keep the logs on the haul road side as this makes the logs always available to the loader



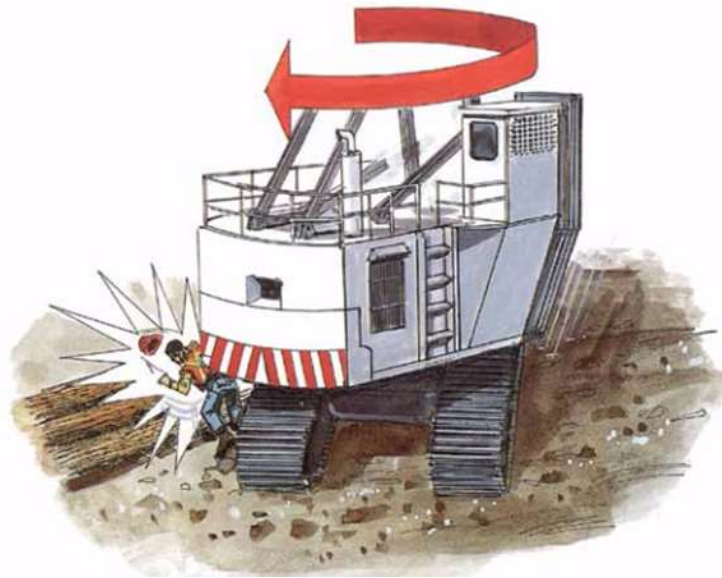
Landing workers must stay in the clear

Passing by log loaders

If you are driving a vehicle, stay well back and in the clear, and give the loader operator time to complete the operation. Do not surprise the operator by driving right up to his loader.

Equipment clearance

A common mistake is failing to maintain a 60 cm (2 ft.) clearance between the counterweight of the loader and any obstacle around it, such as another machine, a log pile, or high side bank. Too often, an operator moving the machine to accommodate yarding or loading inadvertently eliminates this clearance. Operators must always ensure that they maintain the minimum clearance after every machine move. Workers must notify the operator and get permission any time they are entering the loading machine work circle.



The adequate clearance of 60 cm (2 ft.) must be maintained at all times

Machines being struck by logs

Operators of yarders and loaders must position their machines so that they do not endanger one another while handling logs. It is essential for the operators to have effective communication with each other. When they don't, serious accidents may happen, such as:

- Jill-poked logs or logs that slip from a yarder striking a loader
- A loader swinging a log into a yarder
- A loader dislodging a log from the pile and striking a yarder



Loading too close

Landing crew in the clear

The duties of the landing crew (such as the chasers, second loaders, buckers) include tasks that place them in close proximity to machines. For example, a landing worker bucking logs for the loader operator may also have to unhook chokers for the grapple yarder.

All landing crew must perform their duties without putting themselves at risk. Workers who go in to undo chokers or to hook up the strawline must make their intentions known to both the loader and grapple yarder operators. They must not go into the hazardous area until the operator signals it is safe to do so. The landing workers must be visible to both machine operators at all times.

Dislodging logs from the pile

Loader operators must not remove logs from the bottom of a windrow pile. By removing logs from the bottom of the log pile, upper logs can be dislodged. These loose logs may strike the workers or log loader. Loader operators must pick up the top logs first.



Picking up logs from the bottom of the pile can dislodge other logs

Loader coming into contact with yarding lines

When loading close to the grapple yarder, rigging crews have been injured when a loader operator has swung the snorkel or boom into the lines. The loader operator must be cautious when grabbing logs near the lines. When the turn is being brought in, the operator must wait until the log has been landed. If it has been choked, the loader operator must give the chaser plenty of time to get in and out of the hazardous area.

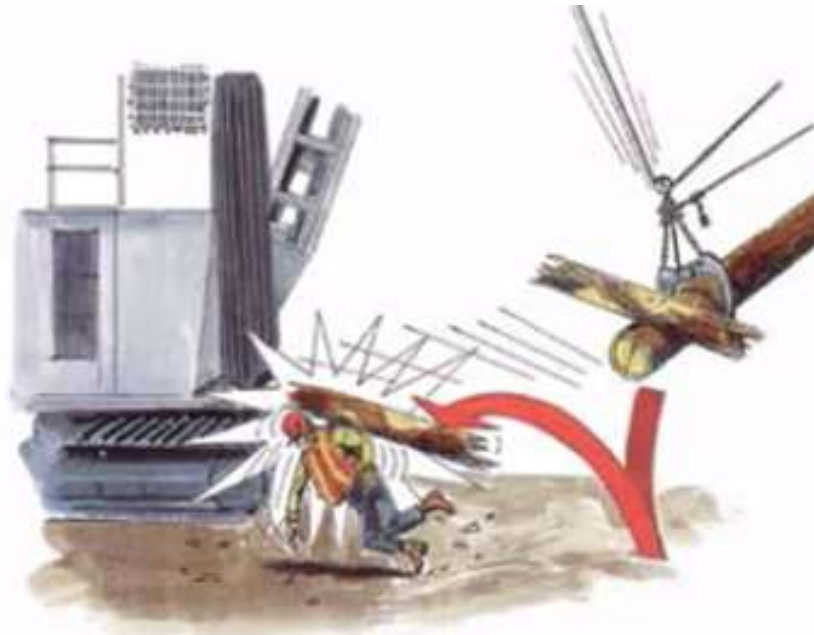


If the loader catches grapple lines, the grapple could swing and hit the spotter

Hitchhikers and long logs

When yarding is done off steep side hills, landing workers must be aware of logs riding on top of a log or grapple and running down into the landing. The same is true of other debris such as rocks or root wads. On settings where there is steep, broken ground, it is difficult to buck logs and there is a greater chance of finding full-length timber. As well, some firms may yard all timber at full length.

Whether yarding is done uphill or downhill, long logs are more difficult to land. When logging is done uphill and the landing area is too small, the loader may be required to hold a log from running back down the hill. Landings must be large enough to handle two thirds of the average length of logs being yarded.



Hitchhiker chunks can ride logs into the landing

Loading below the yarding quarter

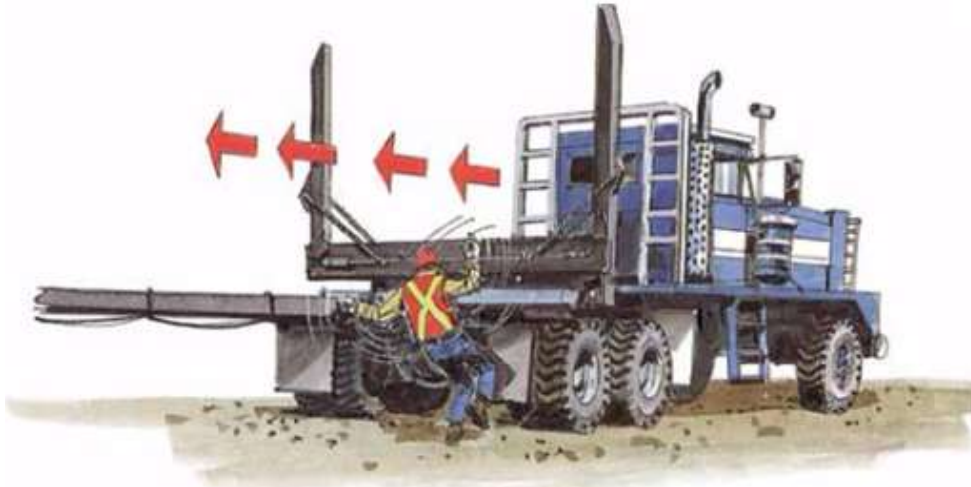
No loading is to take place where there is a danger of runaway logs, rolling rocks, debris, or hitchhiker logs entering the landing. All workers must move to an area where they will not be at risk.

Communications

Effective communications when loading around grapple yarders will prevent many injuries.

All workers must be familiar with all signals used in yarding and loading.

Before backing up, the truck driver must give two horn blasts to notify workers of this movement.



Driver was unaware of landing worker and backs up onto the worker

Now try the quiz on the next page.

Yard Logs or Pile Logs in Accordance with Block Requirements and Manufacturer's Specifications—Self-Quiz

1. The yarder must maintain the 60 cm (2 ft.) counterweight clearance.
☐ True
☐ False
2. Grapple Movement: When you slack the front end (the mainline), the grapple travels toward the tailhold. When you slack the back end point of suspension (the haulback), the grapple moves toward the yarder.
☐ True
☐ False
3. To reduce the danger of runaway logs on settings in which the uppermost part of the setting is very steep, the back end of the setting can be yarded downhill.
☐ True
☐ False
4. To avoid swinging the loader under the lines to grab logs, the setting should be yarded from the front to the back.
☐ True
☐ False
5. Loader operators must not remove logs from the bottom of a windrow pile because by removing logs from the bottom of the log pile, upper logs can be dislodged.
☐ True
☐ False



Now check your answers on the next page.

Yard Logs or Pile Logs in Accordance with Block Requirements and Manufacturer's Specifications—Quiz Answers

1. The yarder must maintain the 60 cm (2 ft.) counterweight clearance.

Answer: **True**

2. Grapple Movement: When you slack the front end (the mainline), the grapple travels toward the tailhold. When you slack the back end point of suspension (the haulback), the grapple moves toward the yarder.

Answer: **True**

3. To reduce the danger of runaway logs on settings in which the uppermost part of the setting is very steep, the back end of the setting can be yarded downhill.

Answer: **False**

4. To avoid swinging the loader under the lines to grab logs, the setting should be yarded from the front to the back.

Answer: **True**

5. Loader operators must not remove logs from the bottom of a windrow pile because by removing logs from the bottom of the log pile, upper logs can be dislodged.

Answer: **True**

Key Point 2.3: Change Roads in Accordance with Block Requirements and Manufacturer's Specifications

There are several procedures for road changes that involve stringing strawline through blocks at the new road line, then tightlining the yarding lines to the new location. Sometimes this is a clearly quicker choice, but these kinds of “jumps” in the line can be hazardous due to potential hang-ups and side binds. Even moving lines no farther than toward the corner block in the existing layout produces a very large bight area. Workers must stay well clear during line shifts that jump lines directly to the new location.

When jumping heavy lines on slopes or uneven ground, use a chain to keep the line from running away when the strawline is released. Attach the chain to the line and to a sapling or secure object.

Single block road change procedure for a grapple yarder

Generally, the single block road change procedure for a grapple yarder is as follows:

1. Hook tender has set up next road change.
 - Hook tender chokes out or spots the last logs on the road line
 - When the last log is going in, hook tender tells the operator to send out the strawline
 - Operator lands last log, swings slack for the chaser so the chaser can undo the haulback shackle from the back of the carriage
 - Chaser hooks strawline from the machine to the haulback eye
 - Operator runs in haulback and pulls the strawline out into the bush
 - Hook tender stops lines when the haulback has pulled extension ends to the correct place for the road change
 - Hook tender brings new extension ends from the new block to where the strawline has been stopped
2. Hook tender pulls slack on the strawline from the machine and undoes the strawline extension connectors and hooks them into the ends from the new block.

- Hook tender steps into the clear, checks for potential side binds, fixes them if required
 - Hook tender gives “go ahead easy on the strawline” verbal command to the operator
 - Operator engages strawline winch and hold slight braking power on the haulback (less than 10 lb. pressure)
3. Hook tender watches strawline start to move, confirms movement of strawline through the new block, confirms strawline starts to pull the haulback. This means all the lines have been hooked together correctly and are holding together.
- This is the last chance the hook tender has to fix side binds easily, after the haulback has tension on it the clearing of sidebinds will be more difficult
 - Hook tender watches and confirms strawline is running through the new block correctly
 - He informs operator that haulback eye has passed through the block. The whole time up to now the strawline has been moving slowly as not to break it by shock loading the line, the haulback eye can sometimes get fouled in the block so it needs to be watched and the line needs to be moving slowly
 - Operator shifts transmission up a gear or two and increases throttle to run the haulback eye into the landing
 - Operator pulls in enough strawline to get the haulback eye close the back of the carriage
 - Operator tells chaser the eye is ready to shackle back to the carriage
 - Chaser comes into work area, undoes strawline from the eye, shackles the eye back to the carriage and hooks the strawline back to the grapple yarder. Hook tender signals operator he is in the clear and everything is hooked back up
 - Operator asks hook tender if hook tender is in the clear
4. When hook tender says “yes,” the operator picks up the haulback while holding the brakes on the mainlines and “tight-lines” the haulback to clear any remaining side binds.
5. Hook tender checks and confirms the lines are straight and running correctly, informs operator to go to work grappling logs.
- Hook tender goes to old block that he just changed off from and undoes the strap, block, and twisters, and pulls the strawline extensions back to the old stump that were cut out of the road change
6. All equipment is packed past and behind the new stump and block to the next one to be rigged.
- Hook tender sets up next anchor while operator grapples the logs off the new road. This is done quickly as time is limited and the operator might run out of wood



Blocks hanging on the anchor

Key Point 2.4: Operate Grapple Yarder Smoothly in Accordance with Block Requirements and Manufacturer's Specifications

Smooth operation of the grapple yarder means increased production, less equipment damage, less down-time and a safer workplace.

It takes time to be able to operate grapple yarder smoothly. It comes with practice to gain the experience. It is important for new operators to show initiative to want to learn and build their confidence and ability over the coming weeks and months.

Steps for running a grapple yarder

The controls are basically the same for all interlock grapple yarders. One handle controls in-haul/ out-haul and the other handle controls swing right or left.

The in-haul and out-haul handle is also called a T bar or controller. It has a neutral position in the middle and indents or ratchets on both the out-haul (towards the back-end) and in-haul (towards the yarder). Here are the steps:

1. With the T bar in neutral and the operator holding the foot brakes down for the mains and the haulback, the grapple will stay suspended off the ground.
2. When the operator pushes the T bar one notch into out-haul the haulback winds line onto the drum and both main and slack-puller turn to let line off their drums. The operator no longer needs to hold the brakes on at all. The farther the operator pushes the T bar into out-haul, the tighter the tension between the haulback coming onto the drum and the main and slack-puller coming off their drums, causing the grapple to lift higher off the ground or clear obstacles. If the operator needs more tension he can apply braking power but there is a risk of breaking lines, pulling back-end stumps or pulling a guy-line anchor.
3. When the operator wants to make the grapple move faster to the back-end in out-haul, the operator applies more throttle which rotates the gear train faster in turn rotating the drums faster.
4. As the grapple approaches the intended log he slows the throttle and moves the T bar to neutral when the grapple is above the log. Applying the haulback, main and slack-puller brakes at the same time.

- If the grapple is too far ahead of the log he slacks the mains.
 - If the grapple is behind the log the operator slacks the haulback.
5. When the grapple lands on the log, the operator applies the brakes again and hits the “close” button on the T bar. This causes the main line to pull line onto its drum and at the same time and exactly the same rate as the slack-puller lets line off its drum, causing the grapple to close. The haulback does not move.
 6. When the operator has the grapple as tight as the operator wants, with a slight belly in the slack-puller, he pulls the T bar into in-haul. This causes both the main line and the slack puller to pull line onto their drums at the same rate. The haulback will let line off its drum at the same time. The operator will let go of the brakes and apply the throttle.
 7. Operator continues to apply the throttle and adjust the T bar to control the path of the log and grapple into the landing. The farther the operator moves the T bar into in-haul the more tension is created lifting the grapple and log higher off the ground.
 8. Operator slows the throttle down as the grapple and log enter the landing area.
 9. When the log is in the correct position to land in the pile, the operator puts the T bar into neutral and applies the brakes. Using the brakes, the operator lowers the log onto the pile until it sits in its spot.
 10. The operator hits the “open” button on the T bar. The slack puller will pull line onto its drum as the main line lets line off its drum, causing the grapple to open. The haulback does not move.

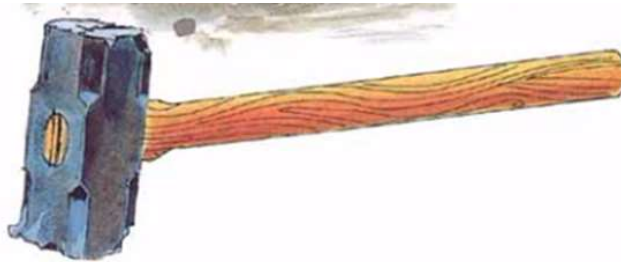
These steps are repeated as necessary.

Key Point 2.5: Spool Lines

Spooling and cutting lines

The operator must not operate the machine and spool lines simultaneously. Proper spooling tools are to be used. Makeshift spooling tools such as a hammer or axe must not be used.

If a hammer is to be used to cut or splice a line, it must be a soft hammer identified by a small “S” stamped on one of the side faces. With use, these hammers become mushroomed and pieces may chip off. Such chips have been known to cause eye injury to workers up to 6 m (20 ft.) away.



Do not use “mushroomed” hammers



PPE Reminder

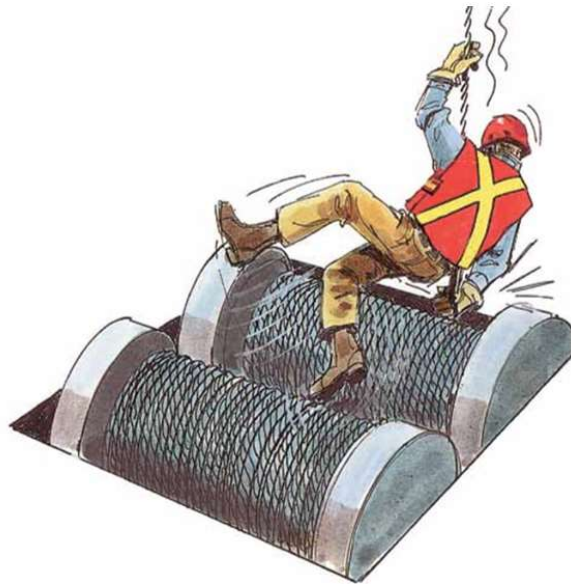
Use eye protection.

Remember the following when spooling and cutting lines:

- Hammers with mushroomed heads must be replaced
- Cutting tools should be sharp and of proper hardness
- Eye protection must be worn during any cutting procedure
- Maintain the proper tip profile on Marlin spikes
- Always use a proper spooling tool when spooling running lines



Examples of spooling hooks



Do not spool lines by hand. Jiggers can catch the gloves

- All access routes and work platforms used when spooling lines must be covered with non-slip material
- Avoid walking on metal surfaces in caulk boots



- Stand with both feet on the platform



Now try the quiz on the next page.

Spool Lines—Self-Quiz

1. Caulk boots are allowed to be worn on smooth steel decks when spooling.
☐ True
☐ False
 2. Operators can spool lines and run the yarder simultaneously.
☐ True
☐ False
 3. Any hammer can be used to cut line, true or false.
☐ True
☐ False
-



Now check your answers on the next page.

Spool Lines—Quiz Answers

1. Caulk boots are allowed to be worn on smooth steel decks when spooling.

Answer: **False**

2. Operators can spool lines and run the yarder simultaneously.

Answer: **False**

3. Any hammer can be used to cut line, true or false.

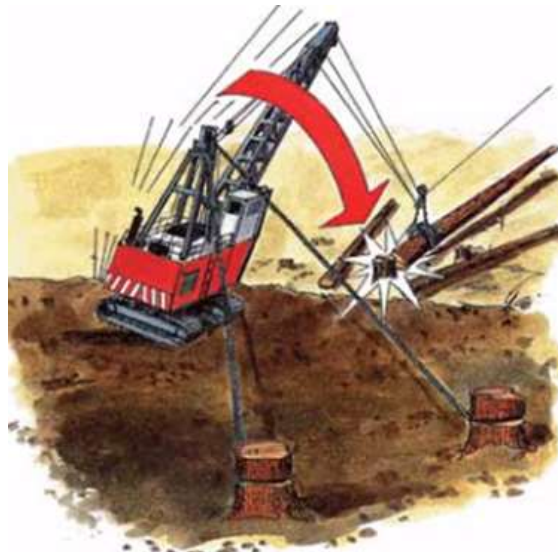
Answer: **False**

Key Point 2.6: Run Guylines

Grapple yarders are manufactured with at least one guyline. The manufacturer requires that the guylines be used. The manufacturer's specifications must be followed. Yarding without a guyline is contrary to the manufacturer's specifications and increases the chance of tipping the grapple yarder.

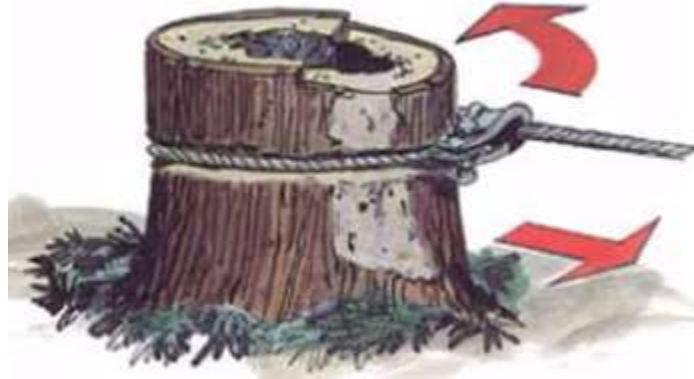


A grapple yarder with a single guyline out of lead can be pulled over

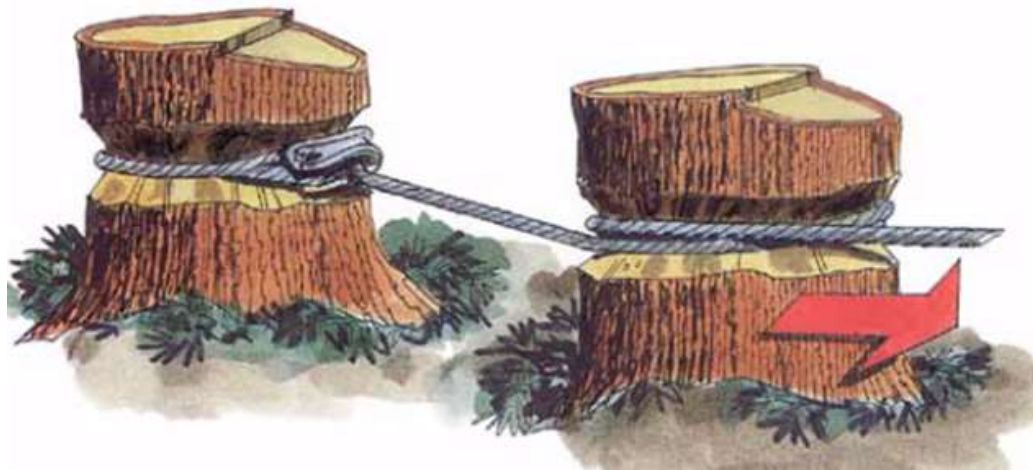


A grapple yarder severely out of lead of the two guylines can be pulled over

The guyline stumps must be properly notched and, when required, tied back with twisters or a wrap of the guyline. The hook tender must inspect the stumps daily to ensure that they are secure.

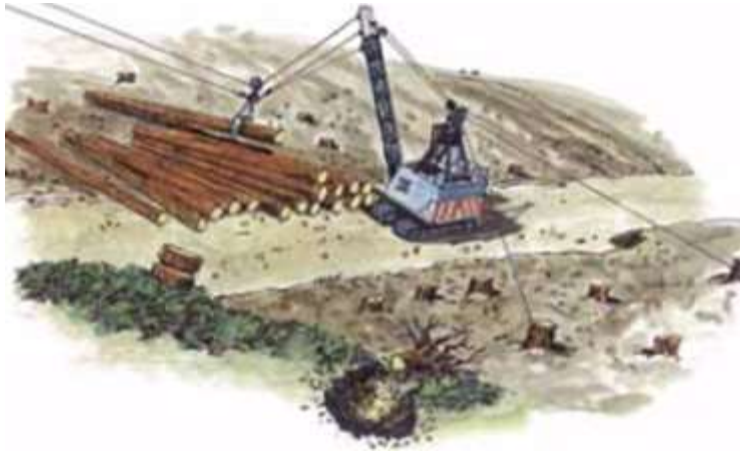


Improperly notched (too shallow) stump. Guyline bight is facing the wrong way



Properly notched stumps with the bight facing the correct way. Stump is tied back with one wrap on the front stump

If a crawler tractor is used for a guyline tailhold it must be kept in lead with the blade down and brakes set. The operator must not sit on the machine while yarding is in progress. The grapple yarder operator must ensure that guylines are kept in proper lead to share the stresses equally. Failure to monitor the lead of the guylines can result in pulled tailholds, broken guylines and equipment, road damage, and serious injury. The guyline tailholds must be changed as the yarder moves so that they are kept in lead with the yarding lines.



These guylines are in proper lead



These guylines are out of lead, causing stump pull and machine rocking
Now try the quiz on the next page.

Run Guylines—Self-Quiz

1. Where can an operator find information on number of, size and placement of guy-lines?
 - ☐ Operator's Manual
 - ☐ Guyline manual
 - ☐ Spec plate
 - ☐ None of the above
2. On a multiple guy-line machine it is permissible to pull on only one guy-line
 - ☐ True
 - ☐ False
3. Most machines require the use of two guy-lines in lead.
 - ☐ True
 - ☐ False



Now check your answers on the next page.

Run Guylines—Quiz Answers

1. Where can an operator find information on number of, size and placement of guy-lines?

Answer: **Spec plate**

2. On a multiple guy-line machine it is permissible to pull on only one guy-line

Answer: **False**

3. Most machines require the use of two guy-lines in lead.

Answer: **True**

Key Point 2.7: Move Grapple Yarder Safely within Block

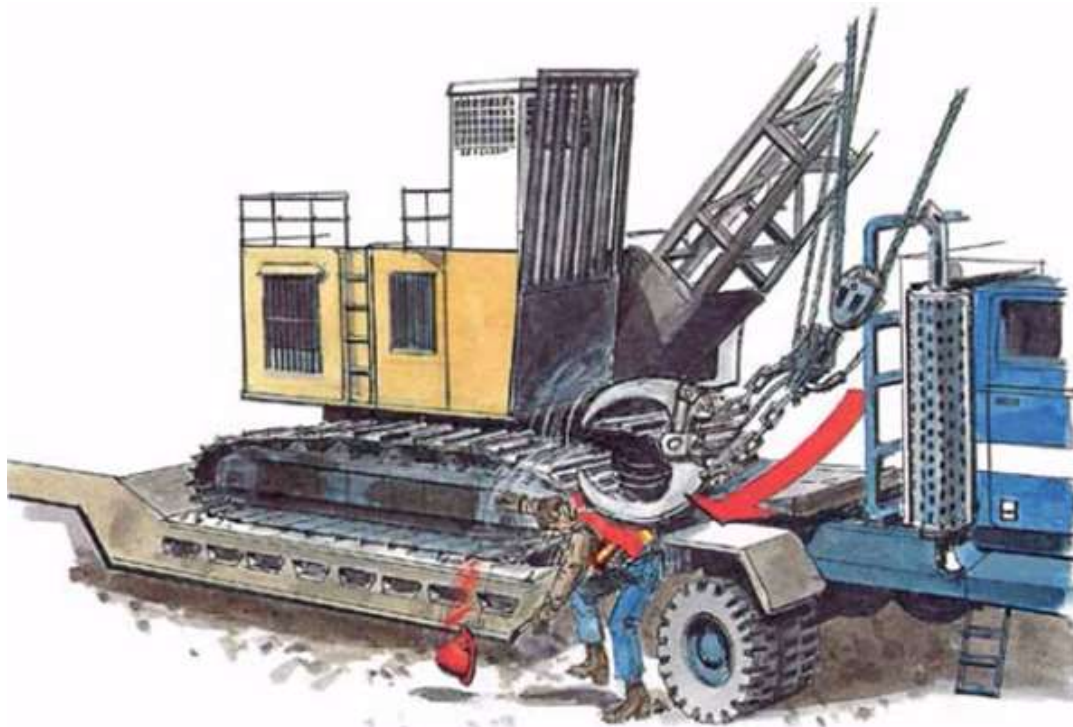
Transporting the grapple yarder

The grapple yarder should be facing the lowbed when walking onto it. All movements must be under direction of a signaler, usually the lowbed tractor operator or supervisor.

Many of the new grapple yarders are hydraulically driven. The power required to drive the hydraulic system may cause the engine to stall at peak hydraulic demand. When loading the grapple yarder onto the lowbed, make sure the RPMs are at the appropriate level to avoid stalling. Refer to operator's manual for proper loading procedures.

When loaded for transport, the grapple must be grounded on the deck or grappled onto a hold-down strap, with the boom lowered. While travelling, the grapple yarder must be tied down onto the lowbed. The increased height while on the lowbed calls for extra caution when passing under power lines.

Unloading procedures must be under the direction of a qualified signaler or supervisor.



The grapple must be grounded (tied) to the lowbed to prevent it from sliding off

Change roads

On established roads there are fewer hazards, provided the road is of sufficient width. Hazards do develop on newly constructed haul roads. Often roads or spur roads are constructed barely wide enough for the tracks. The operator is then forced to walk off centre of the road to the uphill side, with the tracks or tires close to or in the ditch. In that position, the machine can tip sideways. Roads not adequately benched or built with loose side-cast material could give way under the weight and vibration of the grapple yarder.



When the road is too narrow the grapple yarder can be off centre resulting in sideways tipping

Culverts and bridges

Metal, plastic, and log culverts, if not adequately bedded, can shift and collapse. The yarder must not be turned when it is over a culvert. Plugged culverts can wash out under the road surface and collapse. Bridges must be inspected periodically to ensure that the structure is capable of withstanding the load.



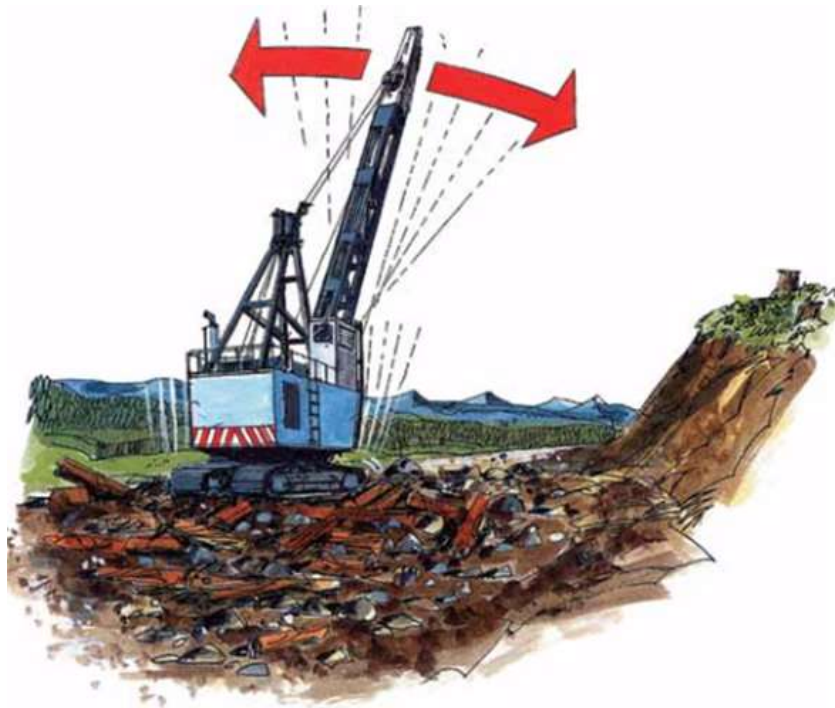
Bridges must be inspected to ensure they can support the loads imposed upon them

Roads covered with debris or snow

When travelling on debris-covered roads, jill-pokes are common, resulting in air lines being broken and tracks derailed. When roads are covered with ice or snow, it is difficult to determine the stability of the road. The road edge may not be visible, or there can be poor traction. Keep the road clear, and be aware of loss of traction from ice buildup between the grousers.

Rock protrusions

Rock protrusions are common on poorly built and poorly maintained roads. These protrusions can cause severe vibration, bounce, and jarring. Such severe movements cause equipment damage and loss of control by the operator.



Walking over road protrusions causes severe shake and can adversely affect the operator

Now try the quiz on the next page.

Move Grapple Yarder Safely within Block—Self-Quiz

1. The grapple yarder should be facing the lowbed when walking onto it.
☐ True
☐ False
2. While travelling what is the right position of Grapple yarder?
☐ Grounded on the deck
☐ Grappled onto a hold-down strap and the boom lowered
☐ Tied down onto the lowbed
☐ None of the above
3. When the roads are not wide enough, the operator is then forced to “walk” off centre of the road to the uphill side, with the tracks or tires close to or in the ditch.
☐ True
☐ False
4. Which item can shift and collapse if not adequately bedded?
☐ Metal
☐ Plastic
☐ Log culverts
☐ All of the above



Now check your answers on the next page.

Move Grapple Yarder Safely within Block—Quiz Answers

1. The grapple yarder should be facing the lowbed when walking onto it.

Answer: **True**

2. While travelling what is the right position of Grapple yarder?

Answer: **Tied down onto the lowbed**

3. When the roads are not wide enough, the operator is then forced to “walk” off centre of the road to the uphill side, with the tracks or tires close to or in the ditch.

Answer: **True**

4. Which item can shift and collapse if not adequately bedded?

Answer: **All of the above**

Key Point 2.8: Operate Safely with other Equipment and Workers in the Landing

In the yarding area, the environment is constantly changing. All workers must constantly assess and re-assess the safety of themselves and the coworkers.

The landing is a dynamic environment with moving logs, machinery, and ground personnel. Workers in the landing need to assess their position and all other activities taking place in the road with yarders, loaders, buckers, and trucks. All movement in the landing must be coordinated and communicated clearly.

Everyone needs to be accounted for visually, with eye contact, and audibly before equipment starts to move.

Never assume that people see or hear you, or that you know where they are and what they are about to do. Make your instructions or requests known and ask for acknowledgement before any movement.

People in the landing need to understand the potential for runaway logs. In addition, they need to take into account the danger area created by the guylines attached behind the yarder.

When yarding downhill, a guyline can pull into the landing area around the yarder. The same issue occurs when yarding uphill, but there is much more strain in the guyline if they are on the high side of the road. If a guyline or guyline stump fail, material can come off the high side of the bank.

If you are working on the landing, stay in a location that has been pre-determined in conversation with the machine operator.

During operation, each machine in a landing has its own danger radius. When people are moving around in the landing, all machines should be inactive.

Everyone in the landing needs to discuss as a group all danger areas and mitigate hazards before starting work.

Designate areas for ground personnel to occupy while equipment is operating.

Follow pre-determined procedures to keep machines and people separated while they work.

Keep the cone of danger away from personnel and equipment, and ask for acknowledgement before moving yourself or equipment.

Now try the quiz on the next page.

Operate Safely with other Equipment and Workers in the Landing—Self-Quiz

1. What must be received from every operator before you enter their machines "danger zone"?
 - ☐ Radio
 - ☐ Voice clearance
 - ☐ Eye contact
 - ☐ All of the above
-



Now check your answers on the next page.

Operate Safely with other Equipment and Workers in the Landing—Quiz Answers

1. What must be received from every operator before you enter their machines "danger zone"?

Answer: **All of the above**

Key Point 2.9: Monitor Performance of Equipment during Operation

General procedure

The following is the general procedure for monitoring the performance of an equipment during operation.

Know the system

- Learn what makes the machine work, how it should behave, sound, and smell.

Operate the machine

- Test and operate all machine functions.
- Note all abnormal sounds, odors, and movements.

Inspect the machine

- Look for leaks.
- Listen for abnormal sounds and locate them.
- Detect the origin of unusual odors.
- Check the condition of the oil and filters.

List the possible causes

- Use good judgment in listing all possible causes of the failure.

Research a conclusion

- Review the list of possible causes and decide which are the most likely to cause the failure. Consider the most obvious first.

Test the conclusion

- Test the conclusions in order of obviousness, until the source of the failure is found. The machine can then be repaired at a minimal cost and downtime.

Review maintenance procedures

- Prevent recurrences of all premature failures by regularly checking the filters, temperature, adjustments and lubrication.
- Make daily inspections.

Section 1021-03: Safety Responsibilities of a Grapple Yarder Operator

What you need to know about this section

By the end of this section, you will be able to demonstrate your ability in the following key points:

- 3.1 Perform shut down procedures
- 3.2 Perform daily maintenance tasks
- 3.3 Perform basic repairs and maintenance on a grapple yarder

Key Point 3.1: Perform Shut Down Procedures

Shutting down the machine

To shut down a grapple yarder, complete the following steps:

1. Remove tension from lines by running buttrigging or carriage out of landing area.

Note: If using a motorized carriage, it is recommended that the carriage be set on the ground in the landing area.

2. With no load, allow engine to run at half throttle for five minutes to allow engine to cool before shut down.
3. Apply spring brakes on all drums.
4. Place engine ignition switch in OFF position to render all controls inoperative.



IMPORTANT!

Make sure to remove the key and swing brake control is in ON position.

Note: To prevent vandalism, close fuel shut off valve at bottom of tank and switch the battery shut-off.

5. Inspect machine as a part of your scheduled maintenance program, and report, in writing, all problems found to your maintenance personnel.
6. Latch all windows, lock cab door, engine house doors, and all access doors.

Special care must be taken to prevent machine damage and component failure when operating under unusual conditions such as:

- Extreme heat, cold or humidity
- High altitude
- Silt water
- Dusty or sandy work sites

By following the recommendations listed for such conditions, major problems can be avoided.

Now try the quiz on the next page.

Perform Shut Down Procedures—Self-Quiz

1. The first step to shut down the machine is to: Remove tension from lines by running the butt rigging or carriage out of the landing area.
☐ True
☐ False
2. The second step to shut down the machine is to: With no load, allow the engine to run at half throttle for 15 minutes to allow it to cool before shut down.
☐ True
☐ False
3. After applying spring brakes on all drums, place the engine ignition switch in the OFF position in order to render all controls inoperative.
☐ True
☐ False
4. Be sure the swing brake control is in the Off position.
☐ True
☐ False
5. To prevent vandalism, close the fuel shut-off valve at the bottom of the tank and switch the battery shut-off.
☐ True
☐ False



Now check your answers on the next page.

Perform Shut Down Procedures—Quiz Answers

1. The first step to shut down the machine is to: Remove tension from lines by running the butt rigging or carriage out of the landing area.

Answer: **True**

2. The second step to shut down the machine is to: With no load, allow the engine to run at half throttle for 15 minutes to allow the engine to cool before shut down.

Answer: **False**

3. After applying spring brakes on all drums, place the engine ignition switch in the OFF position in order to render all controls inoperative.

Answer: **True**

4. Be sure the swing brake control is in the Off position.

Answer: **False**

5. To prevent vandalism, close the fuel shut-off valve at bottom of the tank and switch the battery shut-off.

Answer: **True**

Key Point 3.2: Perform Daily Maintenance Tasks

Daily maintenance checks

Daily maintenance checks include inspecting and servicing the following:

- Lubrication
- Fuel tank drain
- Auxiliary fuel filter
- Controls
- Engine oil (check level)
- Coolant (check level)
- Air cleaner
- Pump drive case

Lubrication

- Lubricate all points indicated on lubrication chart
- Use only those types of lubricants as are specified
- Don't over grease as bearings or seal may be pushed out of alignment

Fuel system

- Drain water from the fuel separator as required
- To avoid contaminants entering fuel tank, always clean around the filler cap before adding fuel
- Tank should be kept as full as possible to minimize condensation

Auxiliary fuel filter

- Water and sediment can be drained from fuel filters by opening the drain cock at base of the filter
- Allow approximately 1/2 cup of fuel to drain from each filter

Controls

- Check all controls daily to ensure proper operation
- Keep all control components free of dirt and grease
- Malfunctioning controls or instruments should be repaired or replaced immediately



CAUTION!

Ensure that all controls are in the NEUTRAL position before starting the engine.

Engine oil

- Allow engine oil to drain back to the sump before checking oil level (about 15 minutes)
- The dipstick is accessible through rear doors of engine house



CAUTION!

Do not check oil level while engine is running or operate engine if oil level is above full mark or below the low mark.

Do not overfill.

Coolant level

- It is recommended that coolant level be checked at least weekly
- Check coolant level with engine stopped
- Maintain coolant level to within 1/2" below fill pipe

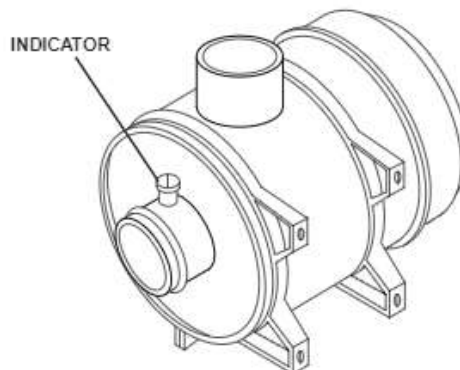


CAUTION!

If coolant level requires checking after engine has run for some time, remember to loosen cap slowly to relieve pressure before removing cap. Pressurized hot fluids can inflict serious personal injury if allowed to escape quickly.

Air cleaner

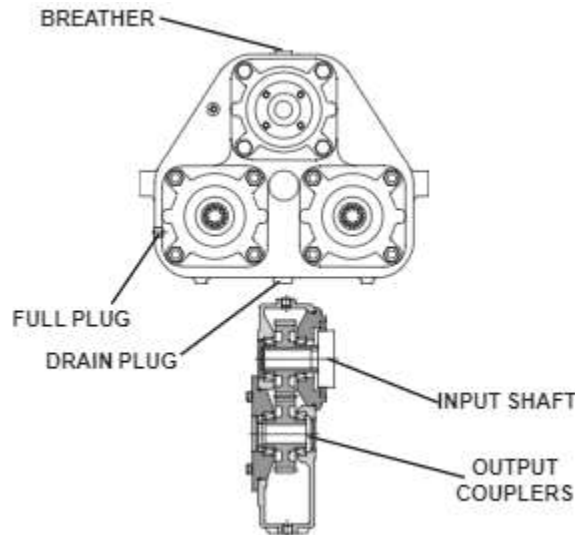
- A clogged air filter restricts engine power output, and must be checked daily
- A vacuum actuated indicator, mounted on the air cleaner outlet neck, indicates conditions of restricted air flow through the air cleaner
- If the red signal is in the service level, with engine running at maximum governed RPM, the air filter needs to be cleaned or replaced



Pump drive case

Access to the pump drive case, filler or breather and full plug is in the rear of the engine house. Oil, with engine NOT running, should just start coming out the hole when the full plug is removed. Over-filling could cause overheating or malfunctioning!

- Clean around the filler or breather before removing it to add oil



Daily inspections

Complete the following steps as part of the daily inspections:

1. At the end of the shift, drain the air tanks to remove moisture and accumulated sediments from the system.
2. Check drum drive gears and drive pinion for proper lubrication.
3. Check for heat and unusual noises that may indicate insufficient lubrication and bearing damage.
4. Inspect the engine and transmission for signs of oil, fuel, or coolant leakage.
5. Inspect all accessories, such as compressor, pumps, etc., and follow the vendor's checklist for each.



CAUTION!

Before loosening any hydraulic component or connection, make sure there is no residual pressure in the lines.

Hydraulic components

- Clean hydraulic valves, motors, pumps, hoses, tube connections, if needed
- Check for leaks and damage

- Check hoses for chaffing or bulges caused by excessive wear
- Keep all fittings and connections tight to eliminate oil leaks
- Repair or replace any damaged components
- Make sure O-rings are in place whenever replacing fittings or connections
- Be sure all parts are cleaned before installation
- Be sure hoses do not twist when fittings are being tightened

Hydraulic fluid level

The hydraulic reservoir fluid level indicator tube, decal and filler port are located on the hydraulic tank. Refer to manufacturer-provided manual for details on hydraulic fluid level.

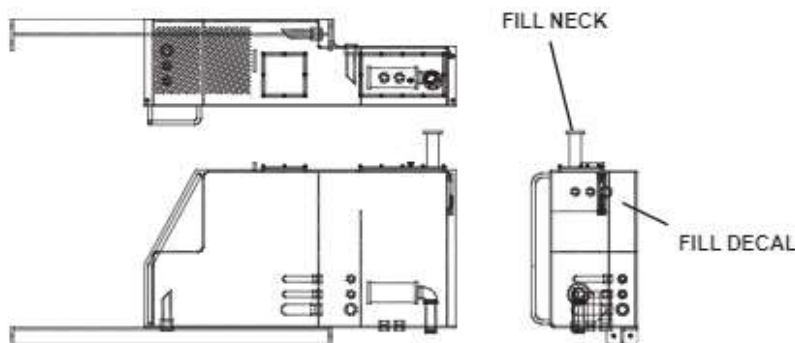
- Make sure the oil level is at the high mark of the indicator tube with all lines full



CAUTION!

Do not overfill.

Do not operate when the oil level is below the low mark in the fluid level indicator tube when all cylinders are fully extended.



Visual inspection

A complete, detailed, visual inspection should be given to yarder each day, before the start operations.

- Report damaged or worn components, and potential problems to the proper maintenance personnel immediately
- Repair or replace any faulty components before beginning operation
- Always keep the machine clean

Now try the quiz on the next page.

Perform Daily Maintenance Tasks—Self-Quiz

1. To minimize condensation, especially in cold weather, the fuel tank must be filled to the bottom of the filler neck.
☐ True
☐ False
 2. All controls must be in the neutral position before starting the engine.
☐ True
☐ False
 3. If the red signal is in the service level, with the engine running at maximum governed RPM, the air filter needs to be:
☐ Cleaned
☐ Replaced
☐ Cleaned or replaced
☐ None of the above
 4. Which of the steps below is part of the daily inspection procedure?
☐ Check for heat and unusual noises that may indicate insufficient lubrication and bearing damage.
☐ Inspect the engine and transmission for signs of oil, fuel, or coolant leakage.
☐ Inspect all accessories, such as compressor, pumps, etc., and follow the vendor's checklist for each.
☐ All of the above
-



Now check your answers on the next page.

Perform Daily Maintenance Tasks—Quiz Answers

1. To minimize condensation, especially in cold weather, the fuel tank must be filled to the bottom of the filler neck.

Answer: **True**

2. All controls must be in the neutral position before starting the engine.

Answer: **True**

3. If the red signal is in the service level, with the engine running at maximum governed RPM, the air filter needs to be:

Answer: **Cleaned or replaced**

4. Which of the steps below is part of the daily inspection procedure?

Answer: **All of the above**

Key Point 3.3: Perform Basic Repairs and Maintenance on a Grapple Yarder

Troubleshooting

It is the responsibility of the operator to detect any unusual sounds, odors or other signs of abnormal performance that could indicate trouble ahead. By detecting any failures in their early stages, unnecessary downtime may be avoided.

It is also the responsibility of the operator to use good judgment in detecting potential failures and repairing them quickly.

Before attempting a repair yourself, ensure that you:

- Have the right tools
- Have the right test equipment
- Have correctly diagnosed the cause of the failure

If you decide to attempt a repair yourself, follow a logical trouble shooting procedure. Don't simply replace parts until the trouble is found. Each trouble shooting procedure consists of a flow chart giving the sequence in which the trouble shooting tests are performed. Each subsequent test is based on the results of the preceding test.

General procedure

The following is the general procedure for monitoring the performance of an equipment during operation.

Know the system

- Study this manual and learn what makes the machine work, how it should behave, sound, and smell.

Operate the machine

- Test and operate all machine functions. Note all abnormal sounds, odors, and movements.

Inspect the machine

- Look for leaks.
- Listen for abnormal sounds and locate them.
- Detect the origin of unusual odors.
- Check the condition of the oil and filters.

List the possible causes

- Use good judgment in listing all possible causes of the failure.

Research a conclusion

- Review the list of possible causes and decide which are the most likely to cause the failure.
- Consider the most obvious first.

Test the conclusion

- Test the conclusions, in order of obviousness, until the source of the failure is found. The machine can then be repaired at a minimal cost and downtime.

Review maintenance procedures

- Prevent recurrences of all premature failures by regularly checking the filters, temperature, adjustments, and lubrication.
- Make daily inspections.

Troubleshooting the hydraulic system

Before attempting any hydraulic troubleshooting, you need to learn some basic facts on the hydraulic system.

Volume

This determines the speed of an operation. A hydraulic pump displaces a given amount of oil for every revolution of the pump. This volume is expressed in terms of gallons per minute (gpm). The greater the engine speed, the greater the pump speed.

As a result, the speed of the hydraulic function is directly related to the speed of the engine.

A reduction in the speed of a cylinder or motor is caused by a smaller quantity of oil being delivered to the components by the pump or by leakage within actuators.

Pressure

This is the amount of force exerted by the hydraulic oil on those parts of a hydraulic system which are open to the pump. Pressure is automatic and the result of resistance, in the sense that, when there is no resistance in the system, there is no pressure. When operating a hydraulic cylinder or motor to accomplish a task, the amount of resistance required to overcome the task results in pressure being sensed by the hydraulic pump.

This pressure is expressed in terms of pounds per square inch (psi). Once a basic understanding of the differences between volume and pressure has been obtained, accurate troubleshooting of any hydraulic system can be accomplished.

Relief valves are installed in a hydraulic system to protect system components. Whenever pressure rises to the relief setting, the effected relief valve opens allowing excess oil to return to the reservoir through an outlet passage in the valve. When checking pressure and adjusting relief valves, be sure hydraulic oil is at operating temperature (140°-160° F). Relief pressures will exceed set levels when the hydraulic system is checked with cold oil. When adjusting pressures, be sure to use a high quality calibrated hydraulic pressure gauge.



CAUTION!

Never resort to increasing relief valve pressure settings in an attempt to cure the ills of any hydraulic system. Fully diagnose the problem and maintain the proper pressure settings of all relief valves. Always set hydraulic relief valves to factory settings.

The majority of hydraulic problems in any hydraulic system can be traced to dirt or contamination in the system. Do not neglect the hydraulic system. Keep it clean. Change the oil and filters at established intervals. Whenever any part of the hydraulic system is to be opened, always remember cleanliness. Clean the entire surrounding area before the work is to be performed. Never set hydraulic components, seals, and rings in a contaminated area.

If, in spite of these precautions, improper operation does occur, the cause can be generally be traced to one of the following causes:

- Use of the wrong viscosity or type of oil
- Insufficient fluid in the system
- Presence of air in the system
- Internal leakage
- Improper adjustments

The intent of the hydraulics system troubleshooting guide which follows is to assist you in isolating problems experienced with the machine. Most problems can be solved by knowing what to look for and where to look. This guide provides a method of identifying and isolating these problems through a logical sequence rather than one of replacing parts at random.

Warning lights and buzzers

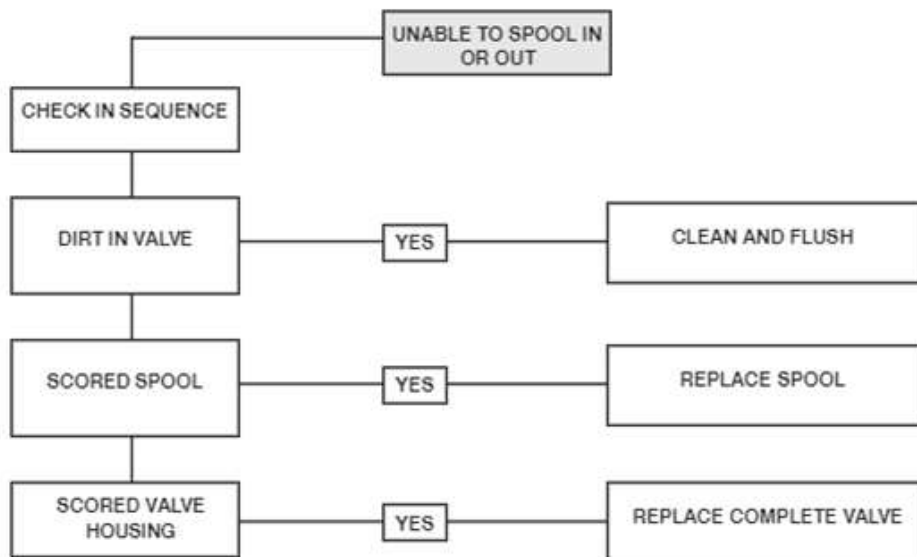
Occasionally warning lights and buzzers will give indications of a potential problem. First it will be necessary to assure that it is not a malfunction of an instrument or a sensor causing the indications.

General troubleshooting procedures

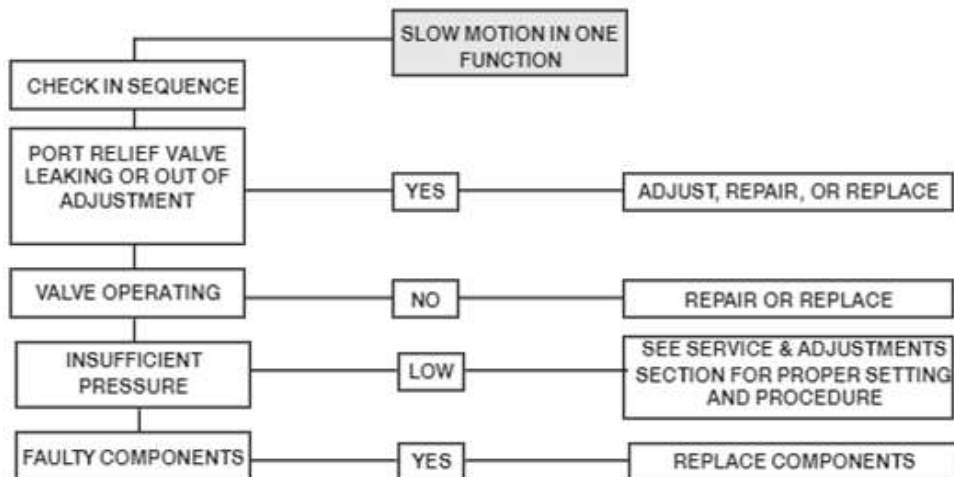
To help in troubleshooting, refer to the manufacturer's procedure settings.

This procedure assumes gauges are installed. The following is written to help the troubleshooter in following a logical approach to a system fault.

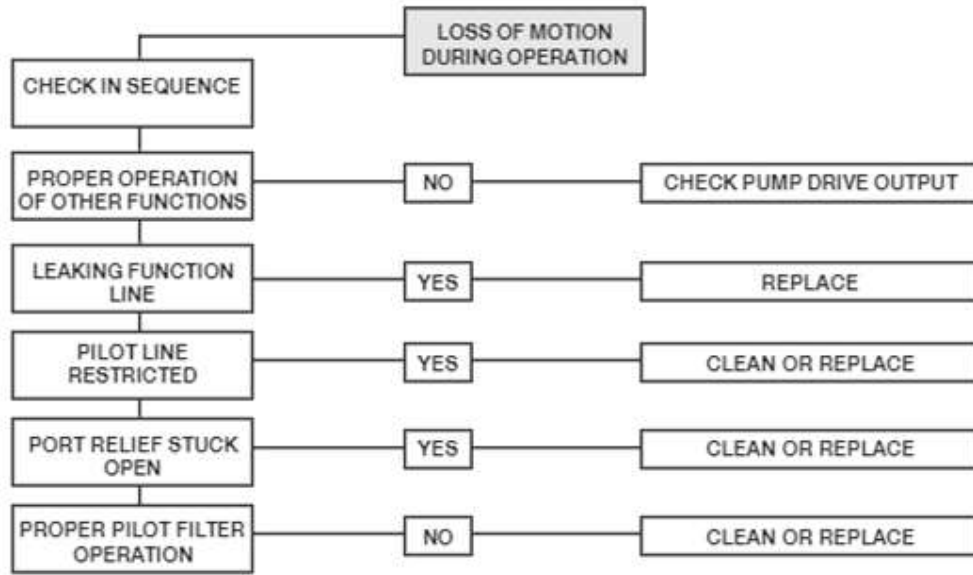
Unable to spool in or out



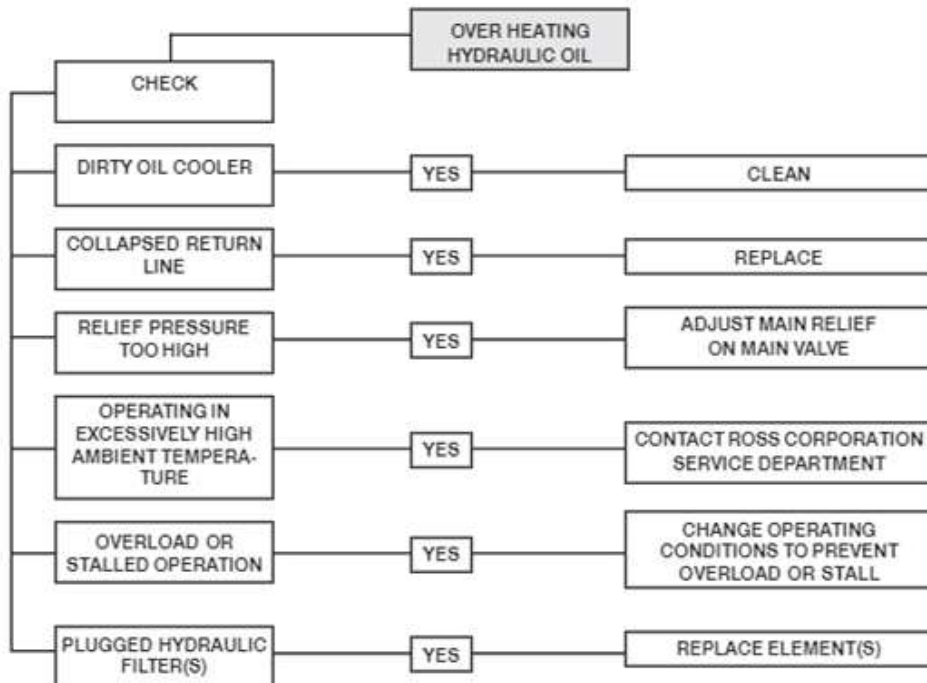
Slow motion in one function



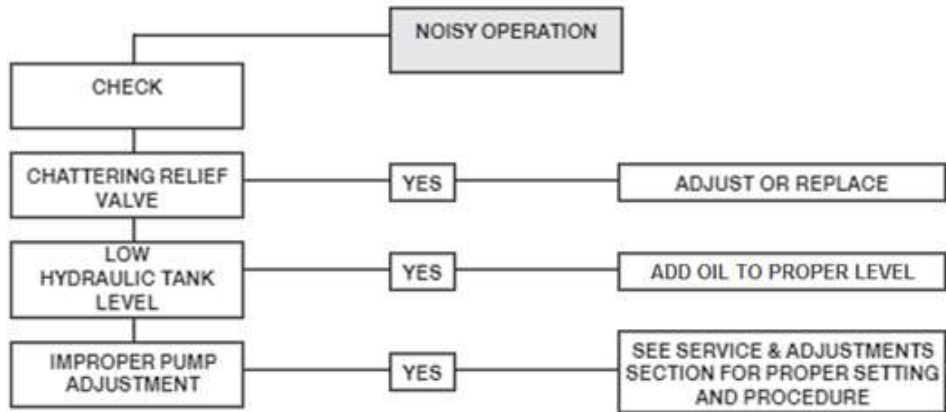
Loss of motion during operation



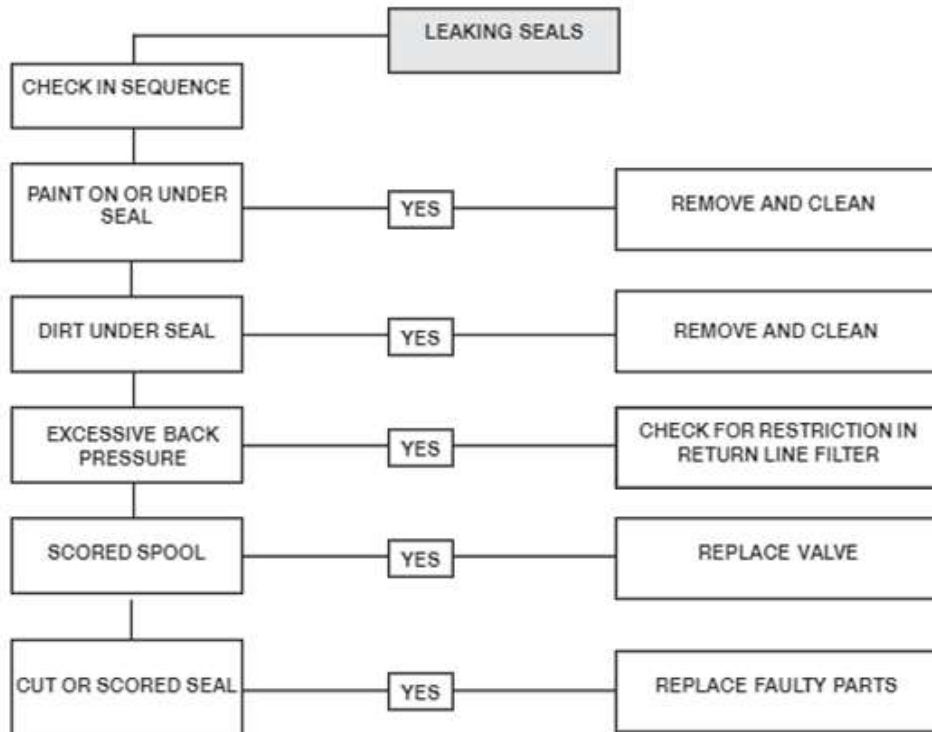
Overheating hydraulic oil



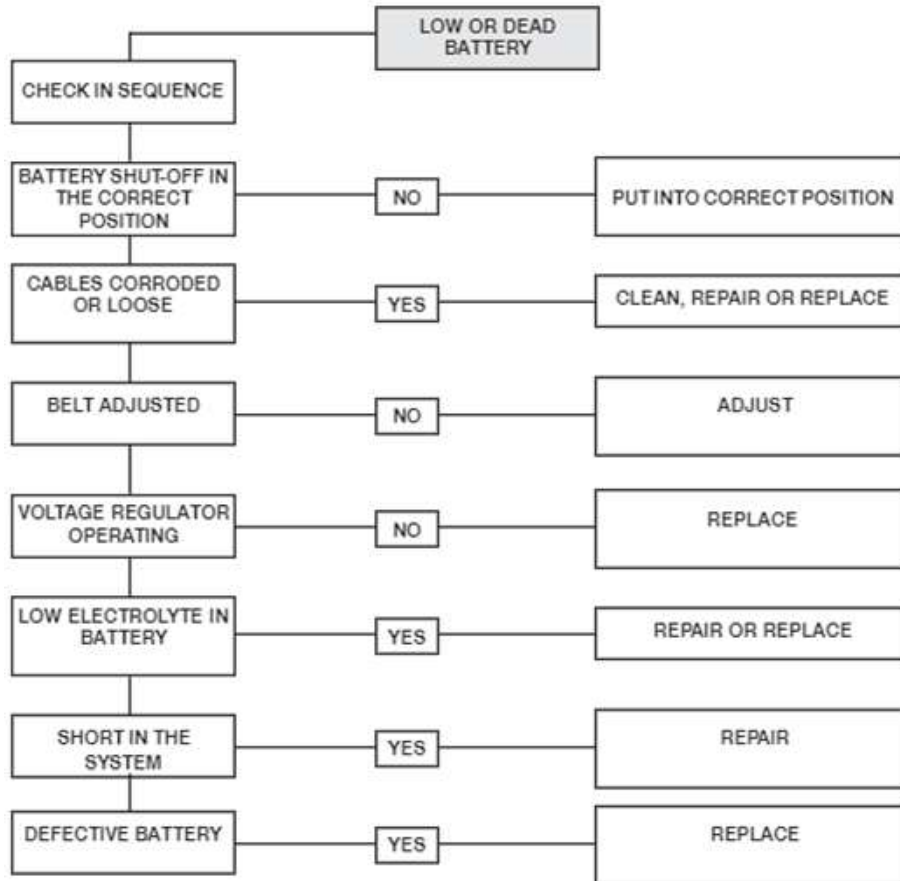
Noisy operation



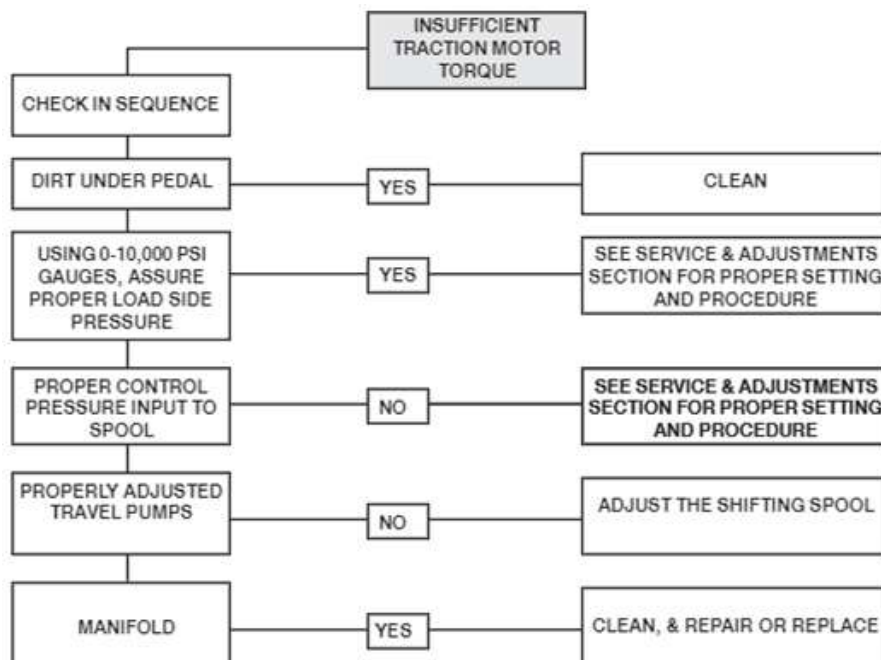
Leaking seals



Low or dead battery



Insufficient traction motor torque



Now try the quiz on the next page.

Perform Basic Repairs and Maintenance on a Grapple Yarder—Self-Quiz

1. A hydraulic pump displaces a given amount of oil for every revolution of the pump. This volume is expressed in what units?
 - ☐ Litres per minute
 - ☐ Gallons per minute
 - ☐ Square meters per minute
 - ☐ None of the above
2. When checking pressure and adjusting relief valves, what is the temperature range of hydraulic oil?
 - ☐ 100°-120° F
 - ☐ 120°-140° F
 - ☐ 140°-160° F
 - ☐ 160°-180° F
3. The majority of hydraulic problems in any hydraulic system can be traced to dirt or contamination in the system.
 - ☐ True
 - ☐ False
4. What is the first action to take if warning lights and buzzers indicate a potential problem in the system?
 - ☐ Ensure that it is not a malfunction of an instrument or a sensor causing the indications.
 - ☐ Inform your supervisor.
 - ☐ Check the manufacturer's manual and fix the machine.
 - ☐ All of the above.



Now check your answers on the next page.

Perform Basic Repairs and Maintenance on a Grapple Yarder—Quiz Answers

1. A hydraulic pump displaces a given amount of oil for every revolution of the pump. This volume is expressed in what units?

Answer: **Gallons per minute**

2. When checking pressure and adjusting relief valves, what is the temperature range of hydraulic oil?

Answer: **140°-160° F**

3. The majority of hydraulic problems in any hydraulic system can be traced to dirt or contamination in the system.

Answer: **True**

4. What is the first action to take if warning lights and buzzers indicate a potential problem in the system?

Answer: **Ensure that it is not a malfunction of an instrument or a sensor causing the indications.**