Unit	1013
Title	Describe Rigging Components and Basic Rigging Practices
Document type	Learning resource

Canada

BRITISH COLUMBIA

Funding provided through the Canada-British Columbia Labour Market Development Agreement.

BC **Forest Safety**

In consultation with industry subject matter experts, the BC Forest Safety Council (BCFSC) facilitated the production of this material. Funding was provided by the Government of Canada, the Province of British Columbia, and industry in-kind contributions.

Feedback is welcome and may be sent to training@bcforestsafe.org.

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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 knowledge of:

- Rigging terminology
- Rigging components
- Basic rigging math
- Use, storage, maintenance, and removal of rigging
- Basic rigging practices

Why it's important for you to learn this unit

To communicate effectively in the industry, you must be familiar with rigging terms and their definitions. For example, the word rigging is defined as the lines, blocks, chokers, and all gear used in cable logging systems.

Knowledge of basic rigging components, their use, maintenance and removal as well as math used in the process brings a better understanding of the due diligence required to keep yourself and your coworkers safe.

Are you ready to take this unit?

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

- 1002 – Describe Forest Industry

Does this unit apply to you?

This unit applies to you if you are in:

- Yarding occupations

Section 1013-01: Rigging Terminology and Components

What you need to know about this section

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

1.1 Rigging terminology and definitions

1.2 Rigging components

Key Point 1.1: Rigging Terminology and Definitions

Rigging and cable yarding make frequent use of many industry specific terms. To make sure that everyone is able to “speak the same language” and communicate effectively, you must be familiar with these terms and their definitions.

A full glossary of forestry terms is available on the BC Forest Safety Council Learning Centre in the online version of this course.

See below for a few of the yarding and rigging terms that you need to be familiar with:

Bight - The hazardous zone contained within lines, either slack or under tension.

Cable logging - A yarding system employing winches, blocks and cables.

Climber- A worker who climbs trees or wooden spars at the workplace.

Drop line -The line to which a grapple or chokers are attached.

Fairlead - A permanently mounted, swiveling roller or sheave arrangement used to permit reeling in a cable from any direction. The area between the two front quarter guylines

Guylines - Used to support the yarder and any tail trees, tails or intermediate supports. Yarders are equipped with drums holding the guylines necessary to support the tower.

Haulback - The cable used to outhaul the rigging or grapple when yarding.

High lead - A cable logging system in which running line lead blocks are placed on a lift tree or on a mobile yarder to provide lift to the logs during yarding.

Hooktender - The foreman in charge of a yarding site.

Intermediate spar - A tree used to elevate a skyline between the yarder and the backspar in a multi-span skyline system.

Landing - The area to which logs are:

- Yarded or skidded for sorting

- Prepared for transportation

Lift tree - A tree rigged to support running lines.

Mainline - The cable used to yard logs.

Mobile yarder - A logging machine mounted on wheels, tracks or skids, incorporating a vertical or inclined spar, tower or boom used in a skyline, slackline, modified slackline, high lead, or grapple cable logging system.

Side bind - An unintentional bight in a line caused by stumps or other objects, preventing the line from running straight.

Skyline - A cable on a yarder that supplies lift for yarding lines, blocks, rigging, carriage and logs.

Slackline - A skyline that can be tensioned at the operator's discretion

Spar - A tree or mast on which rigging is hung for a cable logging system.

Tightline - To lift the lines taut in the air with regards to yarding.

Turn - One or more logs that are skidded or yarded to the landing at one time.

Yarding - The act of moving or pulling logs from the cutting area using mobile or other equipment that does not travel while the logs are being moved. Yarding of logs allows the operator to lift logs over tree trunks and other obstructions and position logs for loading onto trucks.

Rigging Terminology and Definitions—Self-Quiz

Match the following definitions to the correct terms.

1. An unintentional bight in a line caused by stumps or other objects, preventing the line from running straight.

   ☐ Side bind

   ☐ Parbuckle

   ☐ Sidewinder

   ☐ Overburden

2. A permanently mounted, swiveling roller or sheave arrangement used to permit reeling in a cable from any direction. The area between the two front quarter guylines.

   ☐ Bridle

   ☐ Fairlead

   ☐ Saddle

   ☐ Sheave

3. The hazardous zone contained within lines, either slack or under tension

   ☐ Bight

   ☐ Turn

   ☐ Wrap

   ☐ Snare

Now check your answers on the next page.

Rigging Terminology and Definitions—Quiz Answers

1. An unintentional bight in a line caused by stumps or other objects, preventing the line from running straight.

   Answer: **Side bind**

2. A permanently mounted, swiveling roller or sheave arrangement used to permit reeling in a cable from any direction. The area between the two front quarter guylines

   Answer: **Fairlead**

3. The hazardous zone contained within lines, either slack or under tension.

   Answer: **Bight**

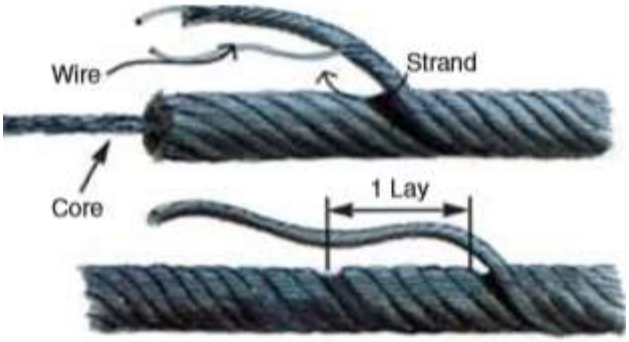
Key Point 1.2: Rigging Components

In this section we will discuss some of the most common rigging components that you are likely to encounter while working. The information that is provided is only an overview of these components to give you the basic understanding of them that you are required to demonstrate.

Be sure to always consult manufacture's guidelines before using any new piece of equipment, and to ask your Supervisor for help with any equipment that you are not familiar with.

Wire rope

A wire rope is a complicated system. A typical 6 x 26 rope has 156 strands. These move independently and together around the core as the rope bends. A rope is designed so that proper bearing clearances will exist to permit internal movement and adjustment of wires and strands.



Grades of wire rope

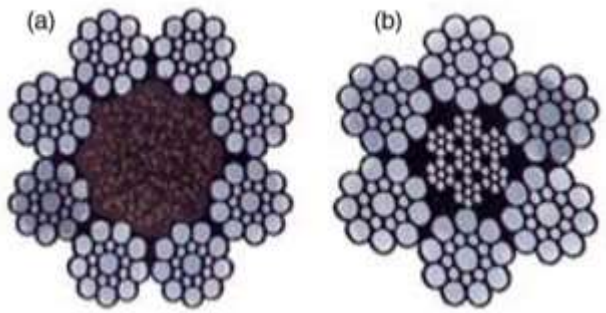
The common grades of wire rope are:

- Plow steel (PS)
- Improved plow steel (IPS)
- Extra improved plow steel (EIPS)
- Extra improved plow steel (EEIPS)

Each type has a different breaking strength. Finishes for wire rope include bright (uncoated) and galvanized.

The core is the foundation of a wire rope. The core is made of materials that will provide support for the strands under normal bending and loading conditions. The core may be a fiber core (FC), either natural or synthetic, or steel. If the core is steel, it could be either a wire strand core (WSC) or an independent wire rope core (IWRC).

A typical wire rope is designated 6 x 26 FW PRF RL EIPS IWRC. This designation means: a six-strand rope with 26 wires per strand (6 x 26), of filler wire construction (FW); with strands pre-formed in a helical pattern (PRF) and laid in a right-lay pattern (RL); using an extra improved plow steel (EIPS) grade of wire; and having strands laid around an independent wire rope core (IWRC).



(a) Fibre core (b) Independent wire rope core

General rope characteristics

Every rope has its own characteristics with regards to the following:

- Strength
- Abrasion resistance
- Crushing resistance
- Fatigue resistance

Strength

The strength of a rope is referred to as its breaking strength. Strength is usually measured as a force in pounds, tons, or Newtons –
1 kip (1,000 lb. force) = 4.45kN

Abrasion resistance

Abrasion resistance refers to the ability of the outer wires to resist wearing away. Abrasion resistance increases with larger wires and decreases with smaller wires.

Crushing resistance

Crushing resistance refers to the ability of the rope to resist being deformed. A rope with an independent wire core is more resistant to crushing than one with a fibre core.

Fatigue resistance

Fatigue resistance refers to the ability of the rope to withstand repeated bending without failure. Fatigue resistance increases with more wires and decreases with fewer wires. The term used to describe the ease with which a rope will bend in an arc is “bendability.”

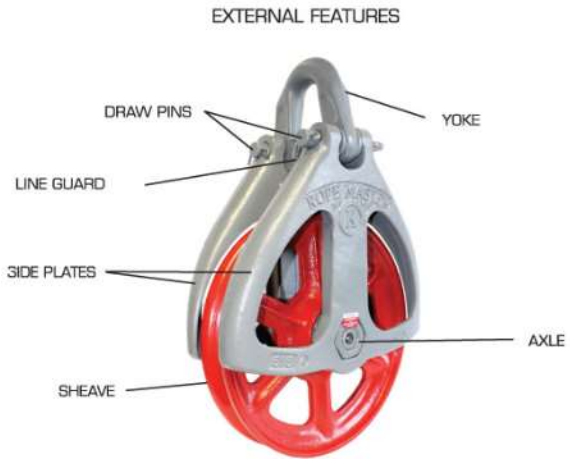
When wire rope is bent around sheaves or any other objects, friction occurs, creating heat that causes the internal lubricant to deteriorate.

Additional friction occurs as the rope stretches and contracts under load.

When stretched past its elastic limit, wire rope will reduce in diameter and not return to its original diameter or strength.

Blocks

A block is a pulley for line to go through. Its construction consists of a metal shell, enclosing one or more sheaves, provided with a hook, swivel, or gooseneck for attachment to an object and is used to change the wire rope‘s direction.



The following are the two main types of blocks used in logging:

- Backend (haulback) block
- Tommy Moore block

Backend (haulback) block

The sheave has a diameter of 14-16 inches or bigger. The haulback line goes through the block and then back to the landing.

Tommy Moore block

This is a wide block with no guards that can be used to handle small and large diameter lines, used primarily for rig ups and other light load situations.

Straps

A strap is any short piece of line with an eye or “D” in each end. They may be made of wire or fabric and serve a variety of purposes.

The following are the three main types of straps used in logging:

- Haulback strap
- Tree strap
- Fabric (soft) straps

Haulback strap

The haulback strap is made of wire and is used to attach a block to a stump or tree, usually 26 to 28 feet long. The diameter of the haulback strap is always required to be equal to or greater than the haulback cable itself.

Haulback strap with backend block

Tree strap

The tree strap is made of wire, with an eye at one end and a choker knob and bell at the other. Typically 10 to 18 feet long and used to attach a lift block to a tree in order to gain lift when rigging the backspar. Due to the force being exerted on it at a smaller angle, tree straps are not required to be as large in diameter as haulback straps.

Tree straps with tree blocks

Fabric (soft) straps

Fabric straps are made of material, such as Kevlar. They may be a continuous loop or have an eye at each end. These straps are used to protect trees from damage when you need to attach things to them or hang stuff off them.

Note: Rachet straps are occasionally used instead of twisters.

Anchors

An anchor stump is used to secure a skyline, guyline, or rigging block.

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
- Species

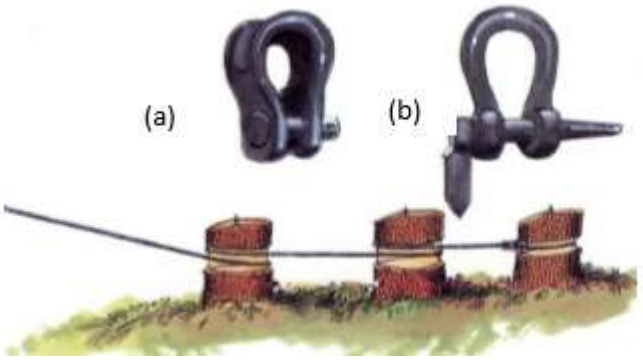
Predicting the holding power of a stump is difficult. Therefore, all stumps used as anchors must be inspected daily. Remember that the holding power of a stump:

- Increases with soil depth
- Increase with soil density
- Decreases as soil moisture increases

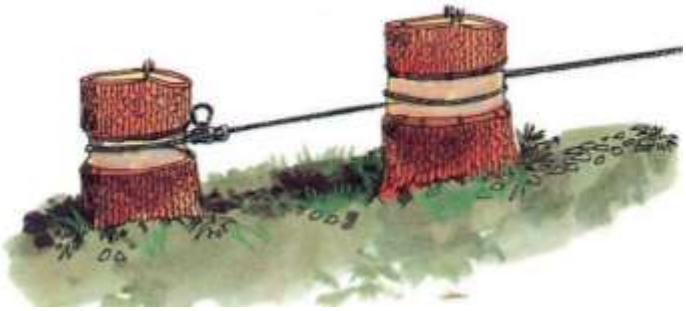
When there is any doubt about a stump's dependability, there are anchoring methods that you can use to increase stability and holding power.

Multiple stump anchors

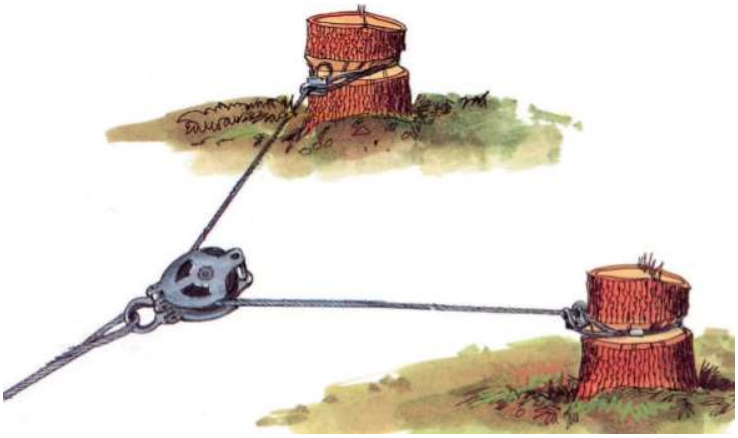
When a single stump is not available or is inadequate, it is acceptable to use multiple stump anchors such as a "wrap and choke." Guylines or skylines must be anchored to stumps with acceptable devices such as flat or bell shackles. Pins must be secured with Molly Hogans or other effective devices



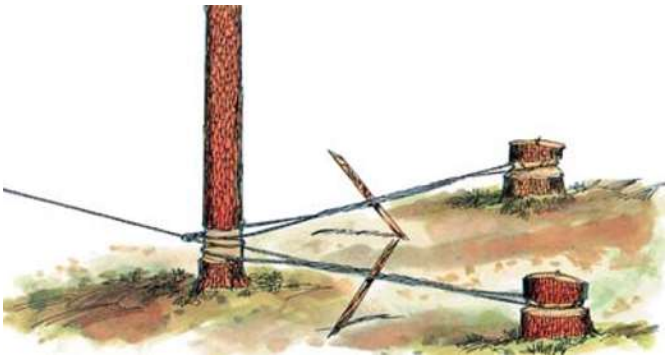
Acceptable multiple stump anchor (a) flat shackle (b) bell shackle



Wrap and choke



Multiple stump anchor using a bridle block

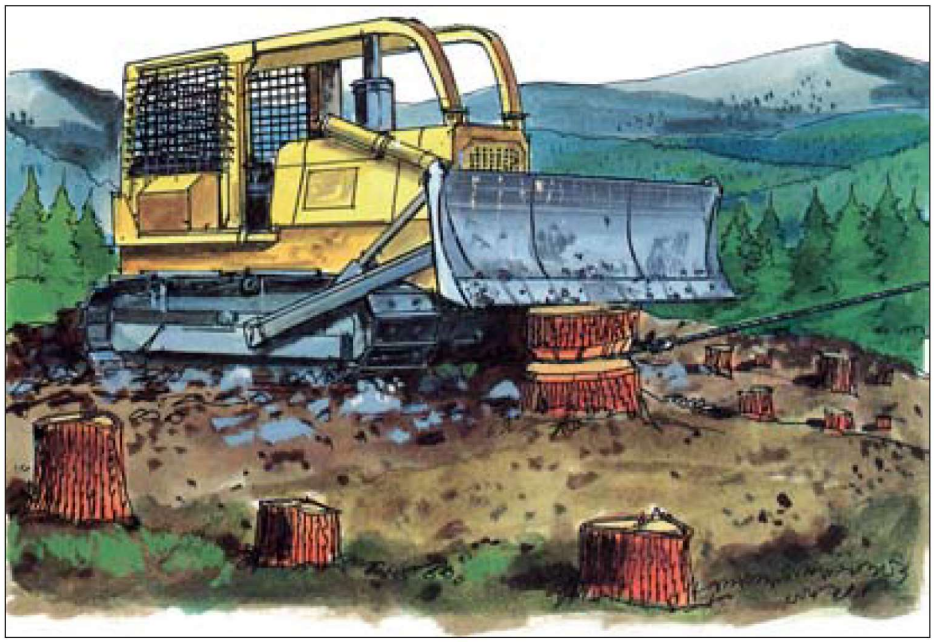


Twisters

Jill-poke supports

Deadweight anchors

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



Alternative anchoring systems

Alternate anchoring systems include the following:

- Equipment anchor
- Earth anchor
- Rock anchor

Equipment anchor

Where stumps have limited holding power, mobile equipment such as excavators, crawler tractors, and front-end loaders may be used.

Consider these points when using mobile equipment to secure stumps:

- Use softeners to prevent line damage.
- Use shackles for connections.
- Do not place the equipment on sheer rock or unstable ground.

Ensure the stability of the equipment being used as an anchor by:

- Placing the blade against a stump
- Digging the blade into the ground
- Tying the equipment back
- Ensuring that the angle between the boom and stick is more than 90 degrees
- Ensuring that the tractor blade is set at 90 degrees to the “C” frame

Earth anchor

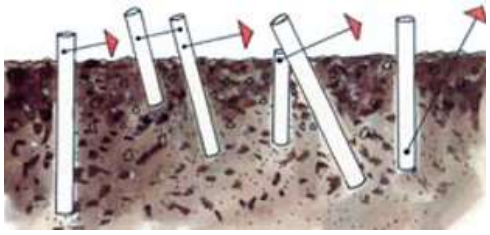
Where stumps are not available or are inadequate, earth anchors are an alternative. Installation requires specialized equipment. Earth anchors have substantial holding power. However, two or more per application are often required.

Earth anchors come in the following forms:

- Pickets
- Screw-in anchors
- Tipping plate anchors
- Bridle blocks
- Deadmen

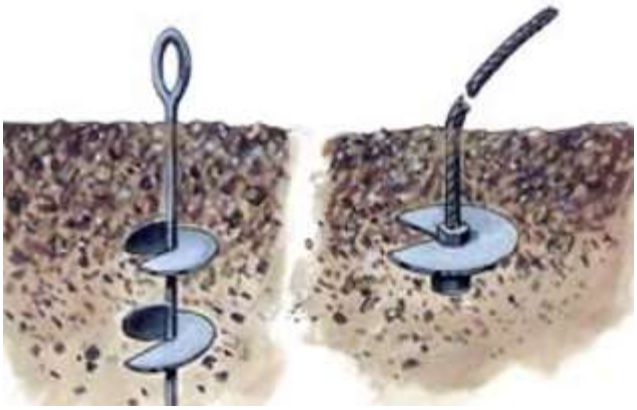
Pickets

Pickets are posts or pegs driven into the ground. They have limited holding power and are time-consuming to install.



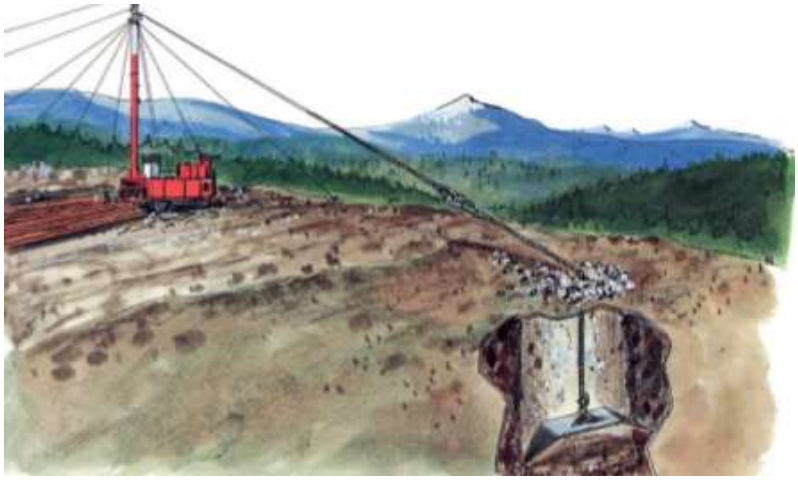
Screw-in anchors

Screw-in anchors resemble augers. They require special equipment and are threaded into the soil to a depth specified by the manufacturer. Installed properly, these anchors are effective, but they are limited to clay, sand, or gravel soils.



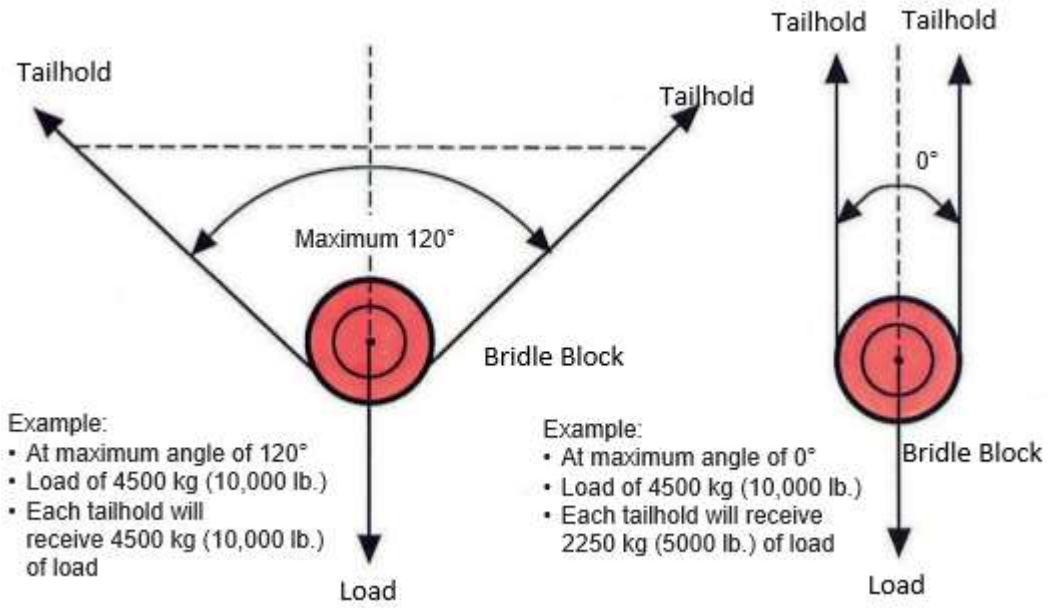
Tipping plate anchors

Tipping plate anchors are used in clay, sand, or gravel. Manufactured in a variety of shapes and sizes, they are effective when installed correctly. Depending on the soil conditions, pre-drilled holes may be required, with subsequent backfilling. Other models require special vibrating installation equipment that forces the anchor through the soil to a pre-determined depth.



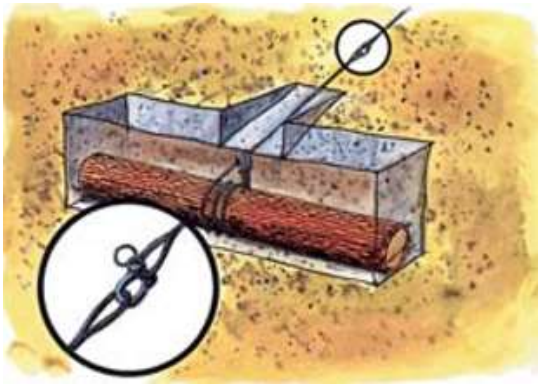
Bridle blocks

A bridle block may be used to distribute forces equally at a tailhold. The angle at the bridle block is critical and must not exceed 120 degrees. If the angle is greater than 120 degrees, there will be greater pull on each leg of the bridle than the original pull; the less the angle, the better.



Deadmen

A deadman is a buried log or logs used for an anchor. Deadmen anchors are used when adequate stumps are not available. The holding power of a deadman depends on soil type, compaction in the front face of the trench, log diameter, and length.



Rock anchor

Where stumps are not adequate as tailholds and solid rock is present, rock anchors may be used. This type of anchor requires special equipment, training, and planning.

When using rock anchors, consider these factors:

- Type of rock – soft, medium, hard, fractured, or solid
- Vertical face or horizontal
- Loads to be imposed

The following are types of rock anchors:

- Galvanized wire rope and steel pins
- Wire rope
- Steel pins

Galvanized wire rope and steel pins

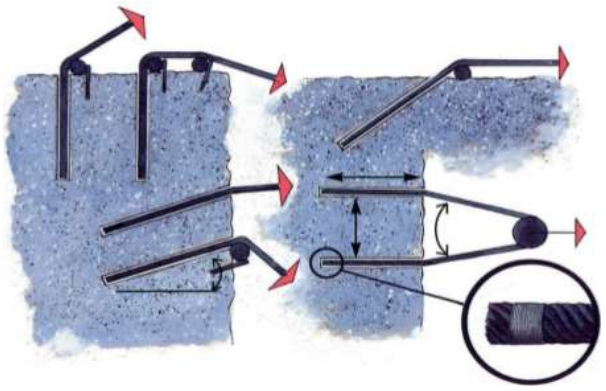
Galvanized wire rope and steel pins are commonly used for rock anchors. Qualified persons must design and install these systems.

Wire rope

Regular wire rope should not be used for rock anchors, because it contains oil-based lubricants that would prevent grout adhesion. Galvanized wire rope, or non-lubricated wire rope, allows grout adhesion and is recommended for rock anchor use. Holes of various sizes can be drilled with a portable rock drill. Drilled holes, pins, and wire rope used for anchors must be compatible to ensure an effective anchor. First, determine the maximum loads that will be imposed on this anchor. If a single-hole anchor with wire rope is to be used, the wire rope must be as strong as or stronger than the wire rope it is connected to.

A shackle should be used to connect wire rope. Under all conditions, wire rope rock anchors must be grouted in place. To ensure a firm hold, the bottom end of the wire rope anchor should be moused (whipped), wedged, or fitted with a ferruled knob.

In rock with limited holding power, multiple anchors may be required. Bridle blocks should be used to distribute loads equally between anchors. When using bridle blocks, take care to calculate for adequate strength and hole placement. Where wire rope passes over a sharp or hard corner, place a softener under the rope for protection.



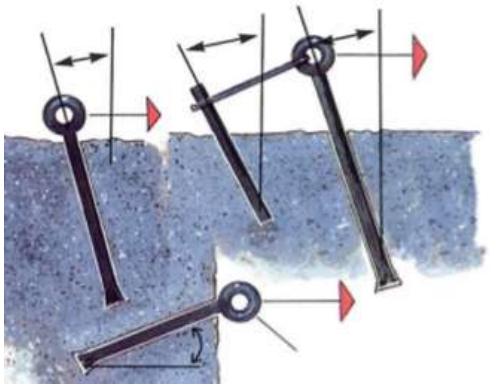
Steel pins

Rock pins must be made from mild steel. Rebar is strictly prohibited. If the pin has an eye, then the eye must be welded closed. Steel pin anchors may be wedged into position, grouted, or a combination of the two.

The bottom end of the pin should be secured by wedging or some form of knob. Drilled rock holes are seldom straight. In order to get a pin to the required depth, it is necessary to taper the bottom third of the pin.

Pins that will not be grouted or wedged must be angled away from the pull approximately 10 to 12 degrees from the perpendicular (100

degrees or more) to prevent the pin pulling out. Pins can be used on a straight pull, providing there is adequate bottom wedging and the rock is medium to hard and not fractured. Grouting provides added holding strength. The hole depth should be a minimum of 1.2 m (4 ft.). Accurate measuring of the hole depth is necessary so that the rod length can be matched. The rod length must allow for the eye to be close to or against the rock surface to allow adequate setting of the wedge at the bottom. The eye must be close to the surface so that a bending movement does not occur. The exception to this is when the rod protrudes above the surface for a cantilever-type tieback. Face the eye weld away from the pull.



Not grouted

Guylines

A guyline is a standing line used to support or stabilize a spar, tailtree, intermediate support tree, machinery, or equipment. Guylines and guyline extensions (stubs) are critical components for yarder stability.

When placing guylines, it is vital that you always refer to the spec plate of each piece of machinery. Each machine capable of cable yarding must have a specification plate, which must specify the following:

- Name of the manufacturer and date of manufacture
- Model and machine serial number
- Minimum size of the skyline mainline and haulback line to be used, if the yarder is designed for skyline slackline or modified slackline systems
- Maximum diameter of the mainline cable
- Minimum size, number, and placement of guylines, if required
- Permissible angles of yarding
- Any auxiliary that may be safely affixed to the mobile yarder
- Placement and number of outriggers, if required

All yarders must be operated within the limits of the specification plate.

Shackles

A shackle is a U-shaped, heavy steel device fitted with a pull-out or screw pin, and is used to secure rigging and lines together, and to attach guylines to stumps.

Rigging shackles

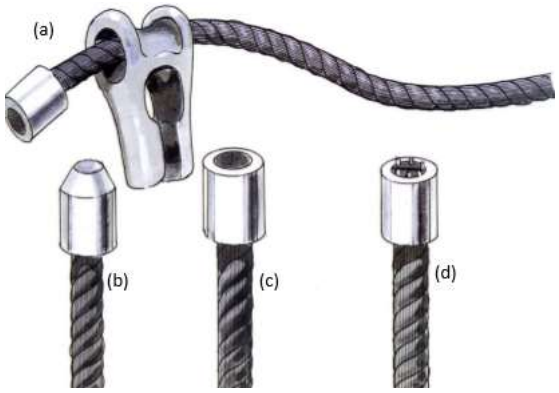
Grapple

A grapple is a set of mechanically-operated hinged jaws which can be opened and closed and is used for grabbing logs for yarding or loading. There are different types of grapples. Grapples on log loaders can be opened and closed hydraulically or by lines. Yarding grapples are operated with lines.

Butt rigging

Butt rigging is a system of swivels, chain-like links, shackles, and bull hooks. It is connected between the haulback and mainline. Chokers are attached to the butt rigging with bull hooks. It allows the lines to spin and reduce torsional tension without wrapping up chokers. Three bull hooks are commonly attached.

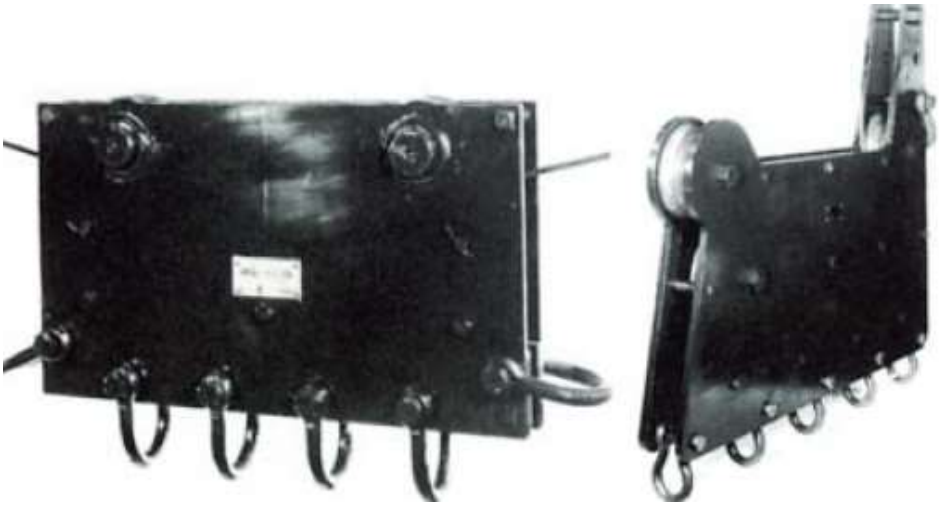
Butt rigging



(a) Choker (b) Pressed ferrule (c) Babbitt (d) Wedge and socket (also known as “quick fix knob”)

Carriages

A carriage is a wheeled, load carrying device which travels freely on sheaves running on a wire rope (skyline) and is used for hauling logs.



Carriage

Hooks

Hooks are used to connect various things. The following are the three notable types of hooks:

- Bull hook
- Strawline hook
- Pelican hook

Drop line bull hooks

Drop line bull hooks hook onto the end of tongs lines.

Strawline hooks

Hook designed to connect the strawline to other lines.

Pelican hooks

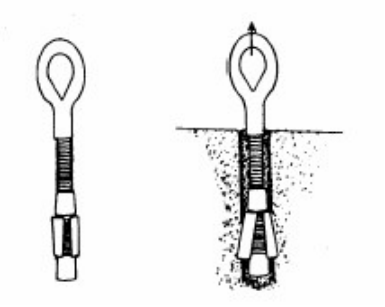
A substantial temporary connector used to secure pass chains or line-stringing equipment that must be disconnected when under tension. A Pelican hook is also called a “finger link.”

Cinches

Cinches are mechanical devices that are used to tighten straps or binders to tie down loads, such as securing a machine to a lowbed or securing a load of logs.

Eye bolt

Eye bolts are generally used as a means to lift equipment, or are attached to rocks to form anchors.



Spreader bars

Spreader bars lessen the risk of the load tipping or sliding as well as the possibility of low sling angles and the tendency of the sling to crush the load. They are most commonly used in logging when lifting loads of logs with an A-frame.

Sheaves

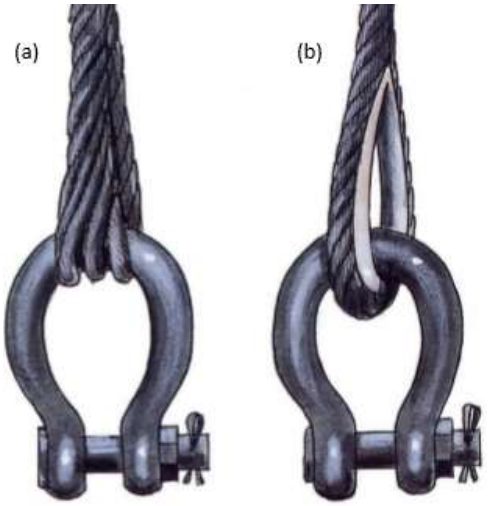
Sheaves are the portion of the block that spins and supports the cable. They can be made out of a variety of materials.

Thimbles

A thimble is a fitting placed in the eye of a rope to protect the eye from wear, prevents flattening, maintains the cylindrical shape of the line, and minimize the loss in line strength where the line contacts a shackle or pin.

Assorted thimbles

Without a thimble, the line will deform as it goes around the shackle or pin. This deformation drastically weakens the line, with a possibility of failure.

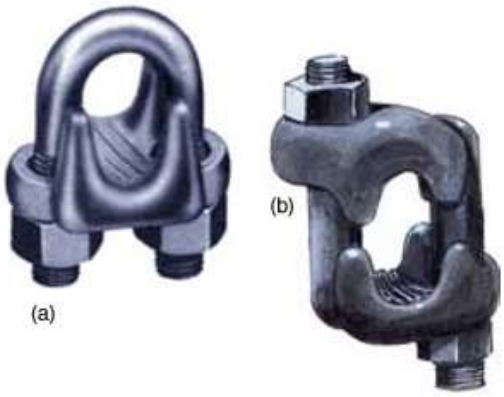


(a) Deformed eye (b) Thimble installed

Cable clamps

A cable clamp (or clip) is a U-bolt cable connector. Cable clamps may be used to form terminals and eyes. When combined with the use of a thimble, this type of terminal can be up to 85 percent efficient. The saddle is always applied to the live line. Placing the U-bolt on the live side may reduce the effective line strength by 50 percent. If both sides are live, use a special cable clip that has two saddles. Always put clamp to the pulling side of the line.

The phrase “Never saddle a dead horse” is a good way to remember this cable clamp procedure.



(a) Single saddle (b) Double saddle

Slings

Slings can be constructed from wire rope or fabric and are used for lifting.

Rigging Components—Self-Quiz

1. A backend or haulback block has no guards and is used to run guylines out.

   ☐ True

   ☐ False

2. Buttrigging is connected between the haulback and mainlines.

   ☐ True

   ☐ False

3. Pins for rock anchors can be made from rebar.

   ☐ True

   ☐ False

Now check your answers on the next page.

Rigging Components—Quiz Answers

1. A backend or haulback block has no guards and is used to run guylines out.

   Answer: **False (A haulback block has guards and is used to change directions of the haulback line)**

2. Buttrigging is connected between the haulback and mainlines.

   Answer: **True**

3. Pins for rock anchors can be made from rebar.

   Answer: **False (Rock pins must be made from a mild steel – never rebar)**

Section 1013-02: Regulations and Standards

What you need to know about this section

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

2.1 Basic rigging practices

2.2 Condition of rigging including use, maintenance, removal, and storage

2.3 Basic rigging math

Key Point 2.1: Basic Rigging Practices

There are many important tasks that you will need to have knowledge of and be able to perform properly in order to keep yourself and your coworkers safe. In this section, we will outline only a few of the basic rigging practices that you will need to master.

Read carefully, and ask questions with anything that doesn't make sense.

Be in the clear

The most important thing to remember when you are out on a work site is to **ALWAYS STAND IN THE CLEAR**!

"In the clear" means out of the way of any foreseeable hazard and includes:

- In the logged off area, if possible
- Above and behind the turn
- Clear of swinging logs
- Out of the bight

Be sure to stand facing the rigging when it is moving and to stand clear of flying chokers. Spot the rigging where the turn is selected. To stop chokers from swinging before entering the work area, slack down or pick up rigging until the choker bells are touching the ground.

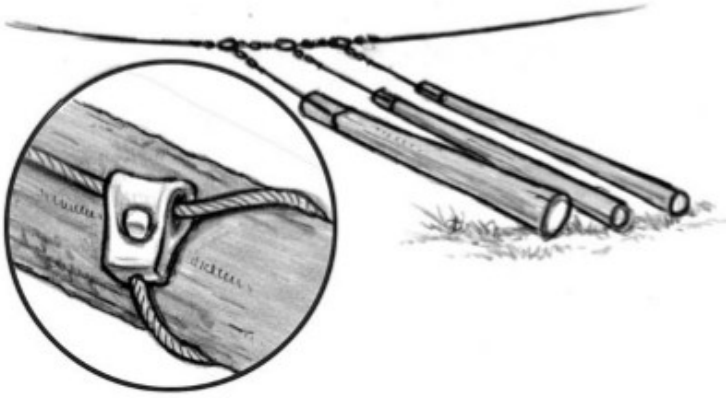
Basic rigging practices

Basic rigging practices include the following:

- Setting a choker
- Hanging a haulback block and strap
- Hanging guylines
- Wrapping guylines
- Carrying blocks

Setting a choker

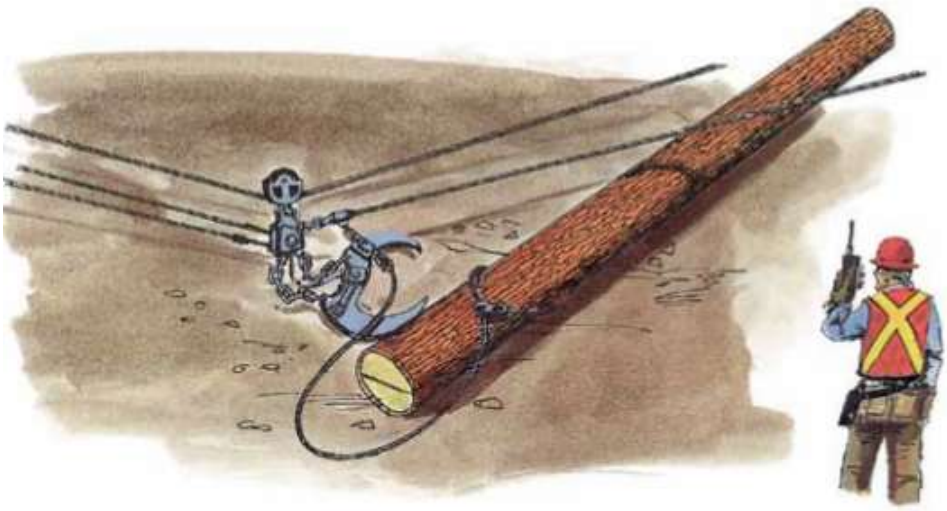
When placing the choker on the log, always go over the top of the log with the knob, unless instructed otherwise for a specific reason. If it becomes necessary to move to the other side of the log to push the knob through, first make sure the log will not roll. Tight logs can be freed by half hitching or other methods. Large, swell-butted logs should be choked at the small end, except for large full-length trees. Chokers must be set on crossed logs to avoid "figure eights," which can cut and damage the chokers. Once the choker is set, move into the clear.



Choke logs with a short end. Hook heavier logs on the front choker.

Remember these points when setting chokers:

- Standing on the high side, always go over the top of the log with the knob of the choker.
- When pulling chokers, walk over and free the choker if it hangs up.
- Watch for unstable logs when setting chokers.
- Do not stand directly under the rigging. Equipment could fail. The rigging or lines could hang up in a sapling or other object and break free, causing the rigging to drop.
- If the rigging does hang up in saplings or other objects, move the lines and rigging to clear it.
- Take the top logs first when selecting turns.
- Assess the logs and always set chokers from the safest side.
- Get in the clear, behind and to the side of the turn.
- Do not gut-hook logs.



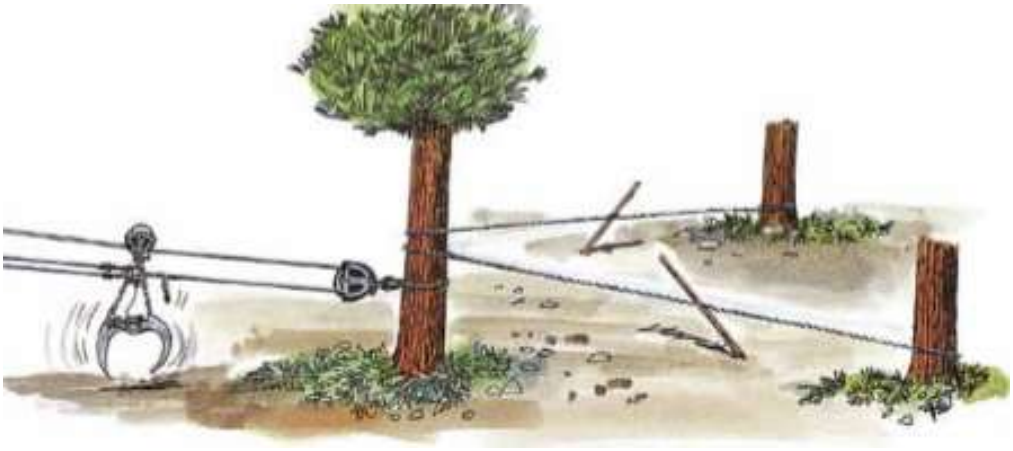
When the choker is used, the grapple must be grounded

Hanging a haulback block and strap

It is recommended that two stumps be used for tailholds to reduce the risk of pulling a stump and to minimize wrapping of the haulback. The stumps must be properly notched and, when necessary, tied back with twisters. The block is to be hung from both eyes of the strap. Do not choke the stump with a strap. If the strap is wrapped around the stump, do not cross the wraps. Ensure that the eyes are in lead with the direction of pull. If you are using a single block, be sure that the eyes are put in the gooseneck so the block hangs upright with no haulback twisting or burning of the block.

Remember:

- Notches must be deep enough to retain the haulback strap
- The block must be hung from both eyes
- Straps must be long enough to allow the block to align itself with the haulback
- The stump must not be choked (threading one eye of the strap through the other)
- The heads of the pins should be positioned to prevent the Molly Hogan end of the pin from being struck and knocked out by the butt rigging
- Hang the strap as low as possible on the stump or tree to reduce the leverage on the root system



The block is hanging upright. All standing trees used for tailholds must be tied back

Stringing strawline

Strawline is usually strung by hand to pull the guyline out or pull the haulback around. The standard procedure is to pull the bight out to the block(s) rather than pull the strawline out and back.

IMPORTANT!

Pull out the strawline as straight as possible in lead to minimize bights and side binds

When the haulback is run around, the hooktender should watch the block(s) to ensure the lines are running clear in the blocks, the straps and blocks are properly aligned, and the straps are correctly positioned in the stump notches. In addition, observe the following:

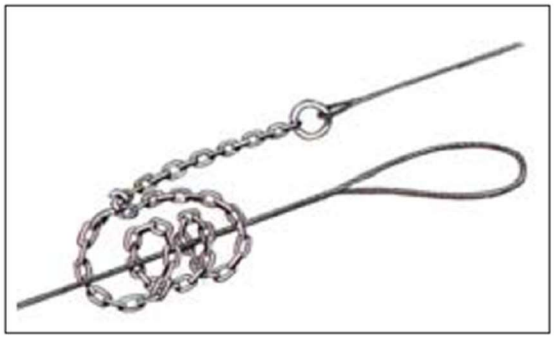
- Avoid crossing lines
- Avoid obstacles or debris that could foul the line and create a side bind when pulled taut
- Stay clear of any moving line. Never assume a line is completely free of side binds
- Slack the line before clearing a side bind
- Before yarding, tightline the mainline, skyline, and haulback to clear any side binds and ensure the stability of the anchors. When tightlining, watch for widowmakers that could be riding on the lines. Tightlining will not correct crossed lines
- Never grab a line near the tailblock. Sudden line movement can pull your hand into the block and sever fingers
- Keep the end of the strawline secured to the base of the tower when not in use
- Make sure the strawline connection is secure and will not come undone when the strawline is slacked

Hanging guylines

Once guyline stumps are selected and notched, guylines are then pulled out to the anchors. On large yarders, this is done with the aid of the yarder strawline. On small yarders, the guylines are normally pulled out by hand. Guylines must be anchored on the stump so that the grapple yarder moves away from the direction of the bight. When hanging or releasing a guyline, stand on the back or clean side of the bight and place the guyline shackle so that it can be taken off safely — that is, stand on the end or eye side of line. Make sure workers are in the clear before going ahead on the strawline or guyline.

Remember the following points when pulling out guylines with the strawline:

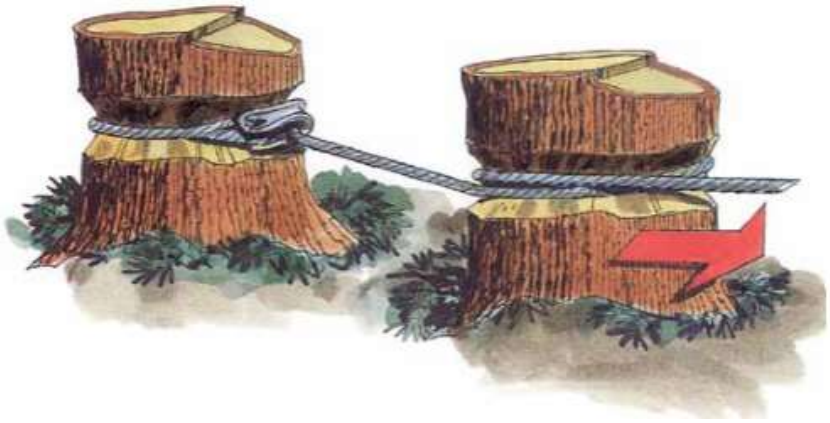
- Hang a light strap and Tommy Moore block on the guyline stump or just behind it and string the strawline
- Connect the strawline to the guyline end with a pass chain far enough up the guyline to provide enough slack for the guyline end to go around the stump
- When wrapping the guyline with the chain, ensure the chain is wrapped opposite the direction of pull



Pass chain wrapped against the pull.

- Place the guyline around the stump with the lead to the tower on the high side. This will make disconnecting the guyline easier
- Use a proper guyline shackle to connect guylines to the anchors
- Insert the guyline shackle pin from the bottom for easier removal
- Place the pin in the eye of the guyline and secure it

The stump is improperly notched and notched too high. Also, the guyline bight is the wrong way



A method of sharing the load between two stumps. Stumps should be notched lower

Carrying blocks

Blocks are heavy and awkward, and carrying blocks in the brush can be hazardous. To avoid back injury, lift the block from a stable stance with knees bent. Pick up the block with both hands by the shell, not the sheave, and swing it onto your back, high between the shoulder blades. This position allows the block to be held in place with one hand by the gooseneck, leaving the other hand free to keep balance while walking. Keep mollies away from your neck or face to avoid cuts.

If you trip while carrying the block, throw it clear. Do not, however, intentionally throw blocks down bluffs. Damage may occur to the block that is hard to see.

Basic Rigging Practices—Self-Quiz

1. When setting chokers, you should always go underneath the bottom of the log with the nubbin unless otherwise directed.

   ☐ True

   ☐ False

2. When using a single block, the haulback block should be hung in an upright position.

   ☐ True

   ☐ False

3. Block should be picked up by the shell and placed on your back.

   ☐ True

   ☐ False

Now check your answers on the next page.

Basic Rigging Practices—Quiz Answers

1. When setting chokers, you should always go underneath the bottom of the log with the nubbin unless otherwise directed.

   Answer: **False (Always go over the top of the log unless otherwise directed)**

2. When using a single block, the haulback block should be hung in an upright position.

   Answer: **True**

3. Blocks should be picked up by the gooseneck.

   Answer: **True**

Key Point 2.2: Condition of Rigging Including Use, Maintenance, Removal, and Storage

This key point does not provide a complete list of all the rigging parts and components that you may encounter. When on the work site, ***use common sense***! If there is a piece of equipment or rigging that you are not familiar with, ask someone how it works before using it. Before you use **any** piece of equipment or rigging, inspect it! If you see any fraying, kinks, broken wires, cracks, deformities, or other damage, do not use it! Instead, bring it to the attention of your supervisor. If you are not sure if a piece of equipment or rigging is safe to use, ask someone!

Remember, careless mistakes cost people their lives. It is your responsibility to exercise due diligence and to protect the safety of yourself and your coworkers.

This key point covers inspection and care for wire ropes, guylines, connections, and splices.

Wire rope

Follow these best practices to maximize the service life of the rope and prevent accidents:

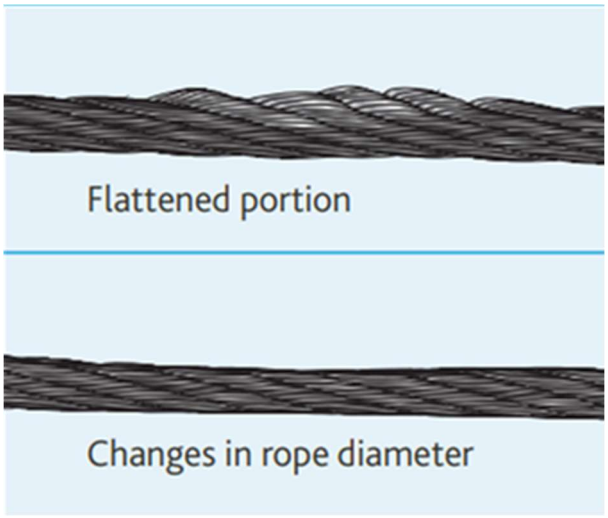
- Do a thorough inspection if an incident occurs including significant shock loading or failure in part of the system.
- Avoid running the cable over sharp bends of rock and other material that could sever the cable.
- Keep a log noting dates and details of cable use hours, cable inspections, any cable damage, any shock loading incidents, and any connector replacements.
- Knots should not be tied in wire ropes.
- Avoid contacting the cable with abrasive surfaces.

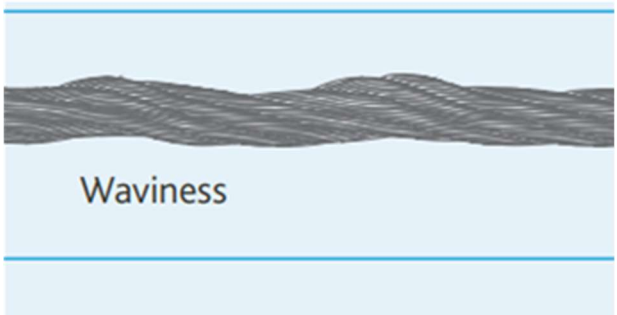
IMPORTANT!

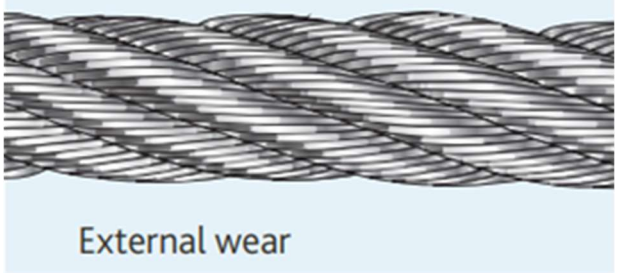
Always wear gloves when handling steel cable. Steel wire fragments will protrude from the cable as it wears.

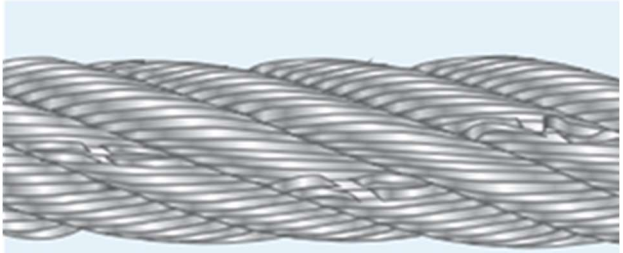
Wire rope must be inspected daily by a competent person and repaired or taken out of service when there is evidence of **any** of the following conditions:

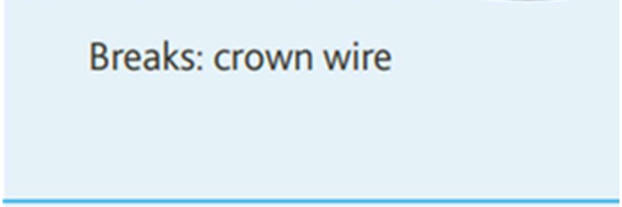
- Broken wires
- Broken wires near fittings
- Severe surface wear and inter-strand nicking
- Crushed, flattened or jammed strands
- Bird caging
- Kinking
- Reduction in rope diameter
- Rope stretch
- Corrosion

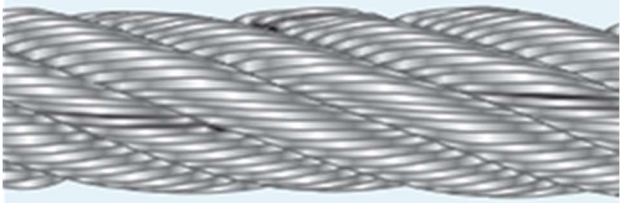


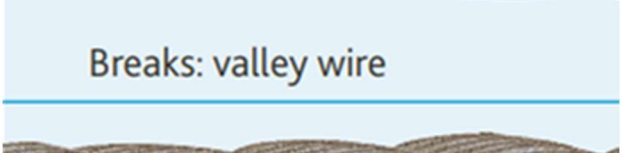


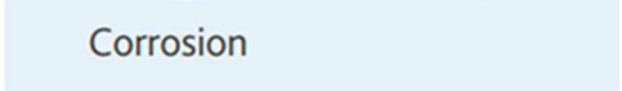






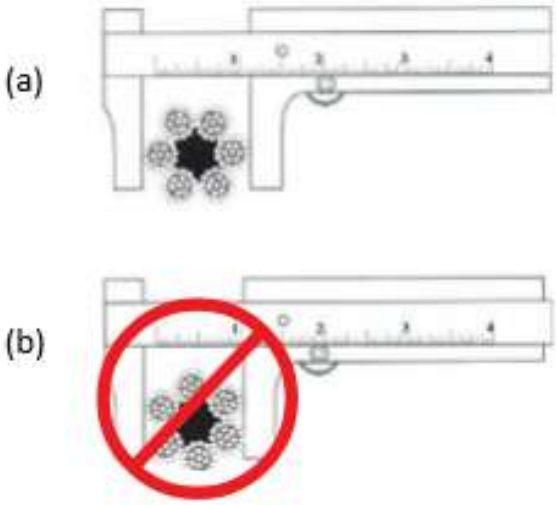






Measure line diameter to detect stretching

A stretched wire rope has a reduced diameter. Check for stretched lines by measuring the diameter, particularly on older lines and any line used in stressful situations.



(a) Correct method – wire measured across crests of the strands

(b) Incorrect method

Make a very close check of those points subject to the most wear, including the knob ends of lines, eye splices, and those sections of line that most often run through blocks or carriages. When in doubt, it is far safer to replace a suspect line, or cut out and re-splice a defective area than risk a failure during operation.

Evaluation of the load-bearing yarder lines should be stringent. A competent person must also inspect all other lines used on site and remove any that are unsafe. Observe the following precautions.

Make sure the working load limit for any line is adequate for the intended task

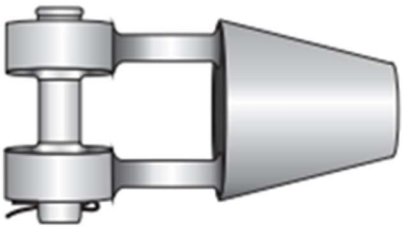
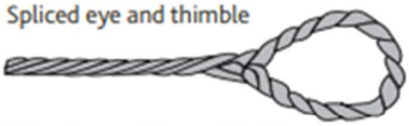
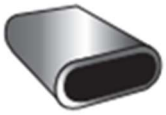
Wire rope has an assigned breaking strength (BS). Working load limit (WLL) is the line's breaking strength divided by a design factor (also known as a safety factor). Engineering calculations and test results determine design factors.

Working load limit is based on a design factor of:

- 3, or 1⁄3 the breaking strength, for running lines
- 3, or 1⁄3 the breaking strength, for standing lines
- 10, or 1⁄10 the breaking strength, for lines used to lift workers

The WLL should be reduced according to the efficiency rating of the weakest connector in the system – see below.

STRENGTH EFFICIENCY OF END CONNECTORS

ATTACHMENT OR SPLICE	Efficiency (% of rope strength)
 Spelter and swaged socket	100
 Wedge socket	70 to 90
 Cable clips	80
  Flemish eye with pressed ferrule	92 to 95 (+6 with thimble)
  Soft eye with pressed ferrule	90 to 95 (+6 with thimble)
 Spliced eye and thimble	80 to 88
 Spliced eye without thimble	<80
 Swaged ferrule	80 to 90
 Split wedge ferrule	Unknown

Pressed ferrules

Pressed ferrules are used by the rope distributor to form wire rope eyes. A Flemish (Farmer's) eye that is secured with a pressed ferrule is generally used for lines that do not require matched lengths. Flemish eyes are 92–95 percent efficient.

Eyes formed with a pressed ferrule and not using a Flemish splice are used on lines requiring matched lengths. These eyes are 90–95 percent efficient. When you are inspecting this type of terminal, one broken wire above the ferrule is cause for rejection. Do not use pressed eyes on standing skylines. Eyes are terminations and they should never pass over a sheave if a line is under load. The ferrules made of either steel or aluminum have been known to crack or break as a result of passing over tree jacks or sheaves. Do not bend guyline or skyline ferrules around stumps.

Eye splices

The eye splice is the most common method of forming an eye. Produced by interweaving the strands with the use of a Marlin spike, this type of eye is less than 80 percent efficient if used without a thimble. Use of a thimble may add as much as 6 percent efficiency. Refer to the WorkSafeBC publication A Manual of Splicing.

Check date stamps and evaluate line life

Standing lines and guylines are often kept in service four to five years without exhibiting any signs of excessive wear other than rust. Inspect the core of older lines periodically for a fractured or dry core, which could indicate other deficiencies such as broken wires, excessive wear, or line deformation.

The life of a wire rope is also affected by hard use. Line life can be measured by the volume of wood hauled. Line life is reduced when a line exceeds its elastic limits, is heavily shocked, or rubbed against rocks or other lines. As a line wears, lower the safe working load limit and adjust the payload.

Check lubrication and abrasion

Wire rope is lubricated in the factory to reduce internal friction and corrosion, and prolong the life of the rope. Heat from friction causes the internal lubricant to deteriorate. Friction occurs when the rope stretches under load, particularly in places where it bends around sheaves or other objects. Commercial wire rope lubricants are available, and all lines should be kept properly lubricated, following the manufacturer's instructions. An improperly lubricated line can pick up particles of dirt and sand that will increase abrasion. Inspect lines carefully for faults in areas where dust and sand collect. Store lines off the ground.

A line log book must be kept in the yarder. Use the log book for entering when the line was installed, up-ended or damaged. Any defects found during inspections must also be entered into the log book.

For regulations pertaining to wire rope rejection criteria, please see the Occupational Health and Safety Regulation, Section 15.25 at

https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-regulation/part-15-rigging.

Guylines, connections, and splices

Inspect knobs, ferrules, and eyes at cable ends for loose or broken wires, and corroded, damaged, or improperly applied end connections. Regularly inspect shackles, hooks, splices, and other connecting equipment for damage and wear. Ensure the connectors are the correct type and size for the line and intended use.

This section covers the inspection of the following:

- Guylines
- Guyline extensions
- Yarding line extensions
- Line terminals
- Pressed ferrules
- Eye splices
- Strawline connectors
- Blocks
- Shackles
- Straps
- In-line splices

Guylines

Guylines are commonly used until external wear or corrosion indicates they should be replaced. When damage to a line occurs, such as severe abrasion, corrosion, or kinking, the line must be removed from service. It is important that guylines are periodically inspected. They often don't show much wear but do deteriorate with time. One method is to open the line to the core. If the core is dry or lacking lubrication, the worker inspecting the line should check for other deficiencies, such as broken wires, excessive wear, or line deformation. If any of these are found, the line must be removed from service.

CAUTION!

Given their function, failure of a guyline has a high potential for a catastrophic incident.

The following practices will damage wire rope and should be avoided:

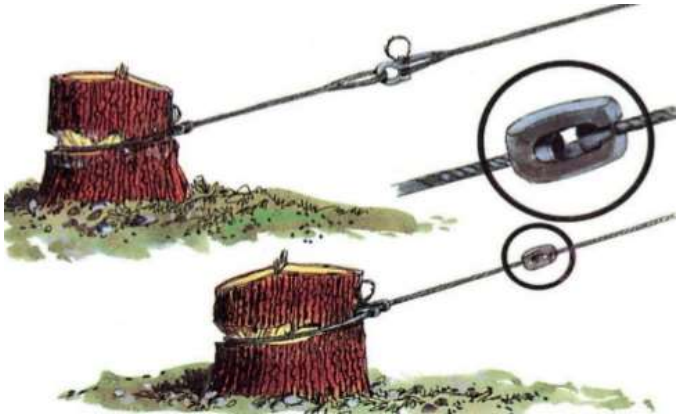
- Pulling guyline stubs behind a vehicle from one setting to another severely abrades the exterior of the line, creates heat, and forces dirt into the line, which then acts as an abrasive in the core and between strands.
- Running over guylines with tracked and rubber-tired mobile equipment, (such as loaders, crawler tractors, and log trucks) during a rig-up or move may cut or severely kink the line.

If the line is coated with dirt or mud, damage is not always apparent. Damage can be eliminated by spooling guylines and stubs properly onto a “line horse,” or placing them in storage where they cannot be damaged by mobile equipment.

Guyline extensions

Guyline extensions must be at least the same size as the guyline and in good condition. The extension must be attached to the guyline with either a guyline shackle or connector. Molly Hogans must not be used to connect the following:

- Guylines
- Guyline extensions
- Skylines



Double-ended guyline connector

Yarding line extensions

Yarding lines should be extended by the use of a long splice, short-long splice, or connecting shackle.

When used, Molly Hogans must be made with a single strand of the same size wire as in the connecting lines and must be made with six complete wraps. Molly Hogans must not be used to connect any of the following:

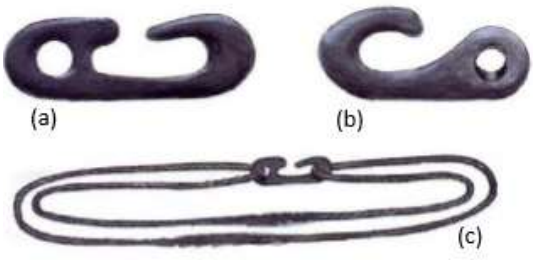
- Skylines
- Loading rigging
- Any stationary lines

Line terminals

Socket knobs or eye splices (as shown in A Manual of Splicing) must be used. Knobs used on guyline connections must be pressed or babbitted. Do not use spiral ferrules or wedged knobs on guylines or guyline connectors.

Strawline connectors

Be sure to inspect hooks for damage and wear, and check that the hooks are the correct size for the lines used. When attaching the hook, ensure the hook will be facing in to ensure a secure connection.



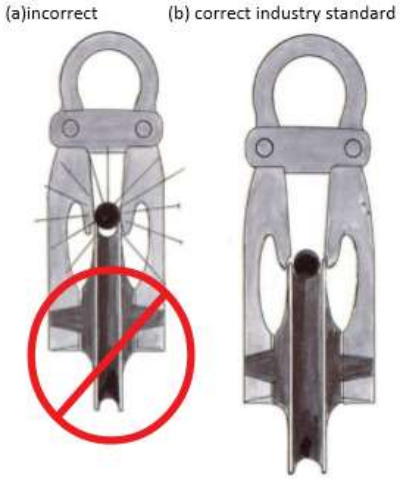
(a) Open hook (b) Closed hook (c) Strawline connection device

Blocks

All blocks used must be of a design and rating to withstand the loads imposed on them.
Guide to block maintenance:

- The sheave sizes must be the correct diameter to minimize line wear
- Check goosenecks for wear
- Inspect line guards and check to see that they are used
- Check for tightness of sheave and shells
- Use proper pins
- Grease the block regularly
- Use proper-sized Molly Hogans in pin holes

The industry standard for calculating the proper block size is to multiply line diameter by 20 and use the corresponding sheave size. Manufacturers recommend a ratio of 30:1 (line diameter to sheave size).



(a) 14 in. block with 1 in. line (b) 20 in. block with 1 in. line

Shackles

Proper bells or shackles must be used to connect the guylines to the stumps, and the guyline lead blocks to the ring at the top of the tower. Connections must have at least 1.5 times the strength of the guyline. The pins of the shackles must be secured against dislodgement, usually with a nut and cotter key, or a nut and molly. Some shackles may use a screw pin. The use of loops or mollies to attach guylines is prohibited.

- Shackles and other rigging must be inspected regularly
- Screw shackle pins should be tightened securely and checked on a routine basis
- Shackles used in overhead rigging must be secured against accidental dislodgment
- Molly Hogans and cotter keys are commonly used to secure shackles
- A Molly Hogan used for securing a guyline shackle should be made of a wire rope strand 13–16 mm (1⁄2– 5⁄8 in.) in diameter

Replace shackles that are bent, broken, or show excess wear on the inner surfaces.

The shackle that holds the haulback eye to the back of butt rigging is never greased and is hand tightened then undone ¼ turn. This is done so the chaser can undo it by hand when attaching straw-line to the haulback at the start of a road change. The lack of grease means the threads on the pin of the shackle won't pick up any debris that will bind it in the hole of the shackle. On carriages or logging systems where the haulback shackle can't be viewed easily (to check if it is coming undone), the shackle is done up tight or a shackle with a lock nut and molly is used.

Straps

Manufacturers provide standards for determining usable life or criteria for retirement for straps. Follow the manufacturer's recommendations. Look for inconsistencies such as:

- Broken or abraded strands
- Kinks
- Eye deformities
- Discoloration
- Inconsistent diameter
- Glossy or glazed areas caused by compression and heat

Strap life is affected by load history, bending, abrasion, and chemical exposure.

Condition of Rigging Including Use, Maintenance, Removal, and Storage—Self-Quiz

1. How efficient are Flemish eyes?

   ☐ Less than 80%

   ☐ 85 to 90%

   ☐ 90 to 95 %

   ☐ 92 to 95%

2. Bending does not affect the life of a strap.

   ☐ True

   ☐ False

3. Mollies are not permitted to be used to connect guylines.

   ☐ True

   ☐ False

4. The sheave size diameter can affect line wear.

   ☐ True

   ☐ False

Now check your answers on the next page.

Condition of Rigging Including Use, Maintenance, Removal, and Storage—Quiz Answers

1. How efficient are Flemish Eye's?

   Answer: **92 to 95%**

2. Bending does not affect the life of a strap.

   Answer: **False**

3. Mollies are not permitted to be used to connect guylines.

   Answer: **True**

4. The sheave size diameter can affect line wear.

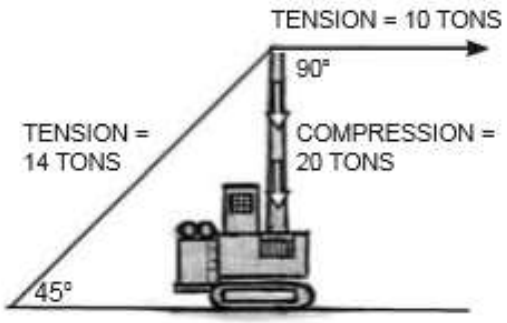
   Answer: **True**

Key Point 2.3: Basic Rigging Math

You may not think that there is much math in the logging industry, but you would be wrong. Safe logging practices require the use of some important mathematical concepts, especially geometry, physics, and algebra.

For example, let's consider the process for determining if a stump has the correct size and location to anchor a yarder guyline.

The holding power of a stump multiplies by the square of the diameter – so double the diameter gives four times the holding power. The equation is modified, however, by factors of soil and species, direction of pull, and zones and angles of the guylines. The angle of the guyline measured horizontally from the anchor point must be no greater than 50 degrees (or the manufacturer's recommendation). Angles greater than 50 degrees can place a buckling force on the tower and cause a catastrophic failure. The smaller the angle, the more effective the anchor.



An anchor above the height of the tower will be less stable. Guylines too far above the tower will create a lifting force that could actually lift the tower off the ground, so you have to examine upward forces on the tower to assure stability.

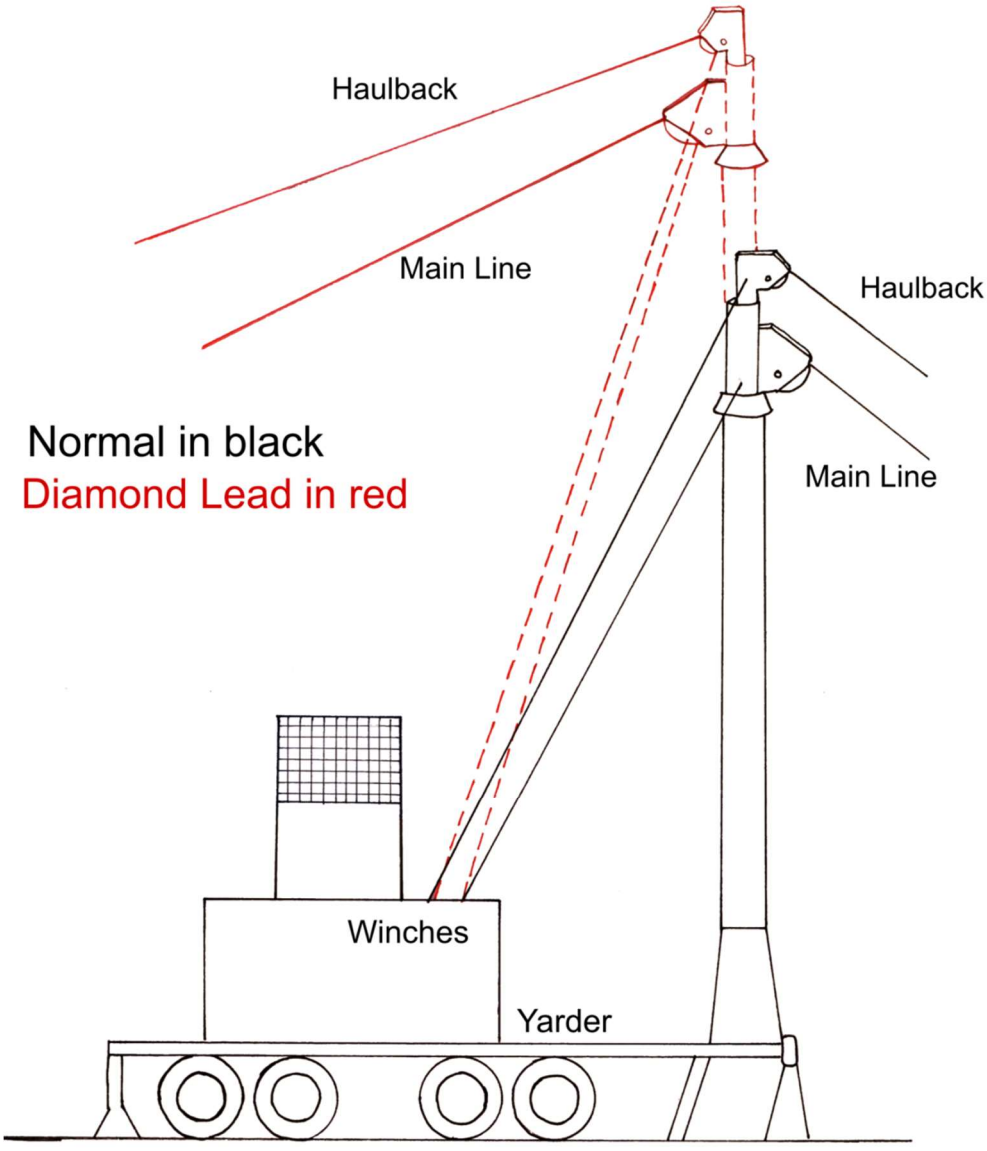
Rigging a backspar

The needs of the back-spar tree to be guylined differ when yarding uphill from the tree or downhill from the tree. When the yarder is downhill from the backspar the block/s behind the backspar will cause the forces on the tree to push it backwards or uphill, therefore the guylines need to be in front of the backspar to oppose those forces. When the backspar is downhill from the yarder and the block/s are behind it, the forces on the tree are pushing it forward towards the yarder, therefore the guylines need to be behind the tree to oppose those forces.

Diamond lead yarding

In normal yarding situations, the winches are on one side of the tower and the yarding happens on the other side. This exerts downward pressure on the tower, pushing it into the ground. When diamond lead yarding happens, the winches and the yarding are happening on the same side of the tower. This exerts a block purchase on the top of the tower.

Generally, towers are rigged with four guy-lines behind the pull (winch side) on the tower and two on the yarding side. When diamond lead logging happens more force is exerted on less guy-lines. If a failure happens the yarder operators cab is in danger of being crushed by the tower falling on it.



Spec plate

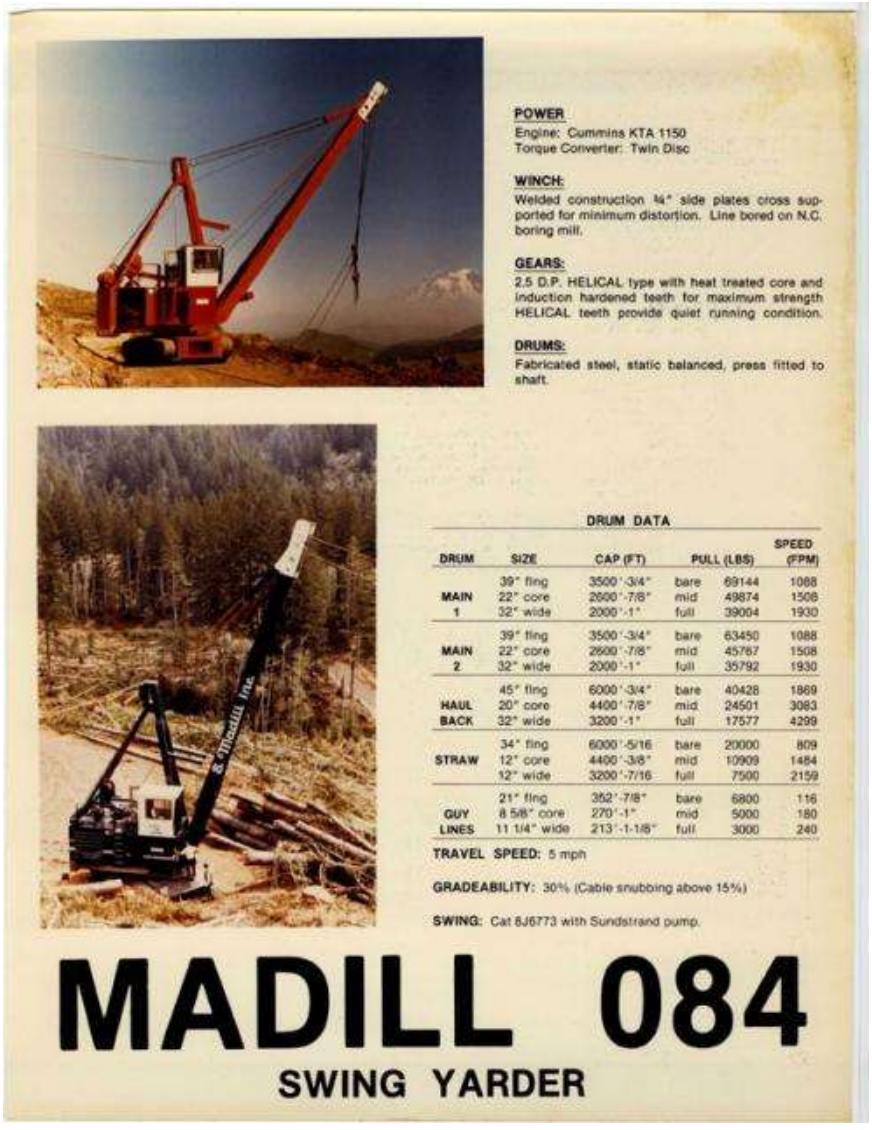
The spec plate is a metal plate welded or riveted to the machine, usually the frame.

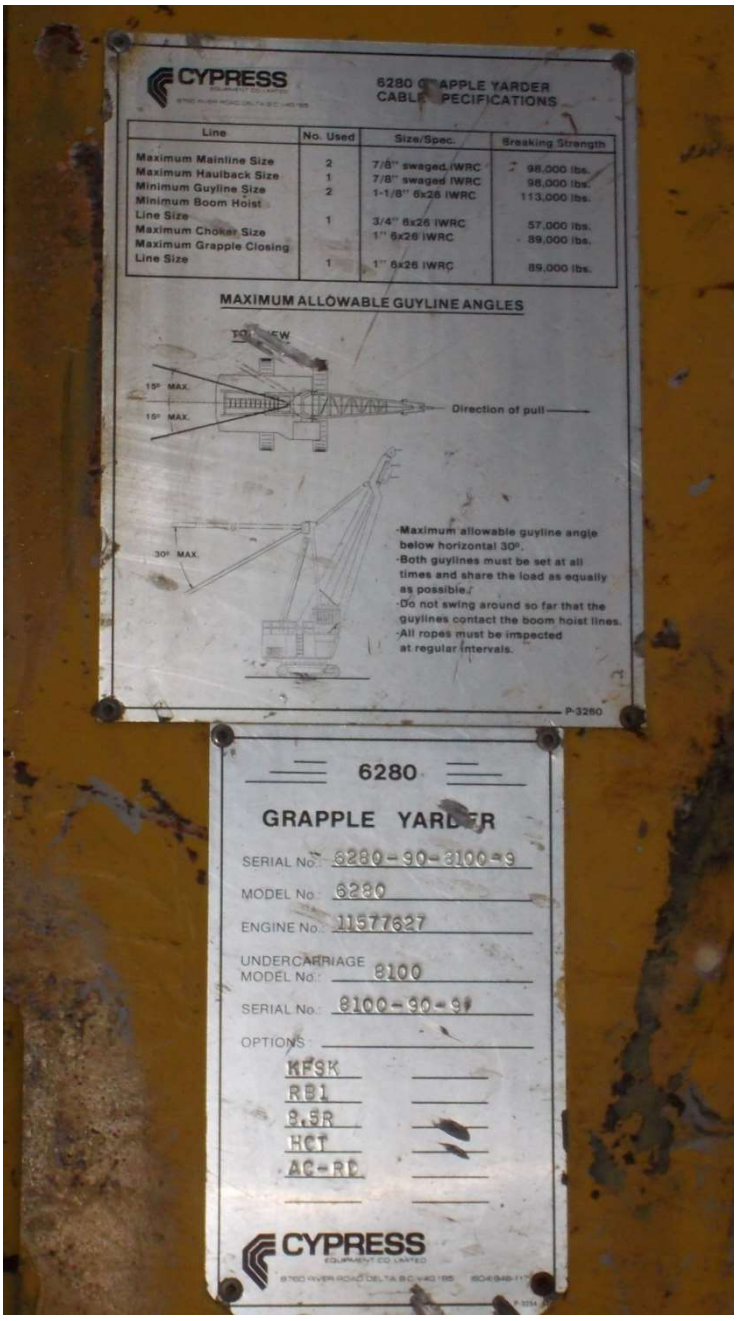
On a grapple yarder, it is at the base of the stair way going up to the cab. On a tower, it will usually be close to the outside guyline controls.

The spec plate has all the information about the maximum and minimum line sizes, as well as the number of and placement of the guylines as suggested by the manufacturer. Some machines will have the model and serial number on the spec plate, others will be on a separate plate.

Do not tamper with or remove the spec plate.

Below are two examples of spec plates.




CYPRESS
6280 GRAPPLE YARDER
CABLE SPECIFICATIONS
Line
No. Used
Size/Spec.
Breaking Strength
Maximum Mainline Size
2
7/8" swaged IWRC
98,000 lbs.
Maximum Haulback Size
1
7/8" swaged IWRC
98,000 lbs.
Minimum Guyline Size
2
1-1/8" 6x26 IWRC
113,000 lbs.
Minimum Boom Hoist Line Size
1
3/4" 6x26 IWRC
57,000 lbs.
Maximum Choker Size
1" 6x26 IWRC
89,000 lbs.
Maximum Grapple Closing Line Size
1
1" 6x26 IWRC
89,000 lbs.
MAXIMUM ALLOWABLE GUYLINE ANGLES
15° MAX.
15° MAX.
Direction of pull
30° MAX.
·Maximum allowable guyline angle below horizontal 30°.
·Both guylines must be set at all times and share the load as equally as possible.
·Do not swing around so far that the guylines contact the boom hoist lines.
·All ropes must be inspected at regular intervals.
P-3280
6280
GRAPPLE YARDER
SERIAL No. 6280-90-8100-9
MODEL No. 6280
ENGINE No. 11577627
UNDERCARRIAGE MODEL No. 8100
SERIAL No. 8100-90-9
OPTIONS
KFSK
RB1
3.5R
HCT
AC-RD
CYPRESS

Basic Rigging Math—Self-Quiz

1. The angle of the guyline measured horizontally from the anchor point must be no greater than how many degrees?

   ☐ 40

   ☐ 45

   ☐ 50

   ☐ 60

2. When the yarder is downhill from the backspar the forces exerted on the tree push it in which direction?

   ☐ Uphill

   ☐ Downhill

   ☐ Sideways

3. In diamond lead yarding, the winches and yarding happen on the same side of the tower.

   ☐ True

   ☐ False

4. A spec plate only provides information about the size and placement of guylines.

   ☐ True

   ☐ False

Now check your answers on the next page.

Basic Rigging Math—Quiz Answers

1. The angle of the guyline measured horizontally from the anchor point must be no greater than how many degrees?

   Answer: **50**

2. When the yarder is downhill from the backspar the forces exerted on the tree push it in which direction?

   Answer: **Uphill**

3. In diamond lead yarding, the winches and yarding happen on the same side of the tower.

   Answer: **True**

4. A spec plate only provides information about the size and placement of guylines.

   Answer: **False (a spec plate provides information about the maximum and minimum sizes of all the lines, as well as the placement of guylines)**