an introduction to

CABLE HARVESTING SYSTEMS

FOR

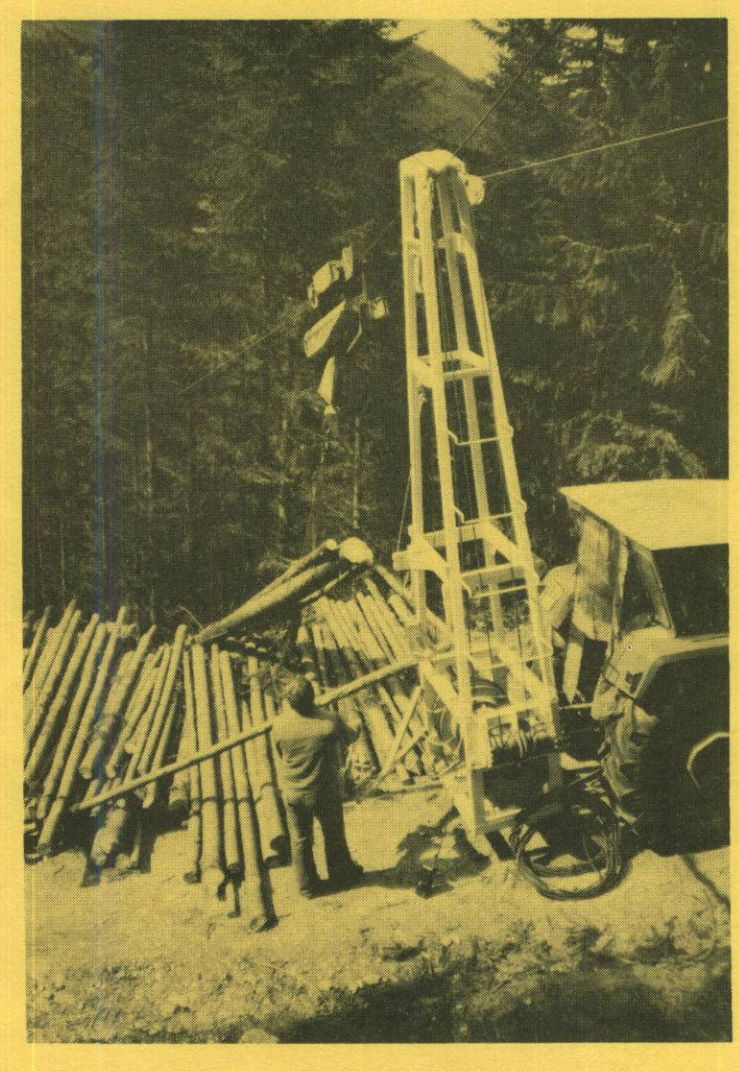
SMALL TIMBER

including descriptions of more than 40 systems

researched and written by:
E. Gerry Hawkes

under contract with:
The Vermont Department of Forests,
Parks, and Recreation

February 1979



With funding provided by a grant from the U.S. Forest Service, State and Private Cooperative Forestry through the Improved Harvesting Program.

TABLE OF CONTENTS

PREFACE

This publication has been prepared as part of the "Vermont Department of Forests, Parks, and Recreation's" effort to upgrade forest management through improved harvesting methods.

The information which follows is intended to provide the reader with a general understanding of the wide range of cable harvesting systems in use throughout the world and how these systems could or could not be employed to improve harvesting of small and medium sized timber.

The various systems can not be neatly categorized, but have been grouped to facilitate description. In general the systems which show the most promise for yarding small timber economically under varying conditions have been described first and in more detail than those which follow. It is advisable to read this publication in the order it has been written since a good understanding of a system may be based on the descriptions of preceding systems.

No attempt has been made to include every known cable system, nor has any attempt been made to include every detail in the descriptions of each system.

Special thanks are given to the researchers and manufacturers who so generously contributed background information and illustrations for this publication.

E. Gerry Hawkes

"Woodland Balance"
-forestry services-
Woodstock, Vermont

February 1979

INTRODUCTION

The Need for Improved Harvesting Systems

A growing human population
A declining timber supply

Decreasing tolerance for environmental disturbance
Increasing logging costs

Decreasing size of private woodland ownerships
Increasing size of commercial logging machinery

Demands on forests for lumber, fiber, and fuel
Demands on forests for recreation, watershed, and wilderness

These are just a few of the growing problems demanding new approaches to forest management. A quote from the *Forestry Handbook* illustrates the importance of harvesting to forest management.

"Logging has been called the key to forestry. Even in forests managed primarily for purposes other than wood production, some cutting is often inevitable. The best silvicultural plan can be wrecked by poorly planned or careless logging. Moreover, because logging costs are usually the major item in the total cost of forest products, and are rising, efficient and economical logging is essential to sustained yield forest management."

Meeting the Need

Cable systems, properly designed for the timber and the terrain, and operated by skilled, conscientious crews, are not an instant panacea, but they can be judiciously employed to meet increasingly high standards of forest management. Properly designed and operated, cable yarding systems can offer many of the following ADVANTAGES over conventional ground skidding with tractors (1):

-little or no soil disturbance or compaction
-no streambed disturbance
-economical yarding of thinnings with little residual stand damage
-ability to operate safely and efficiently on steep and rough terrain
-ability to yard in adverse weather and over poor ground conditions (mud, snow, etc.)
-less wear on machinery since only the cables and carriages travel to and from the forest
-less maintenance
-longer service life
-lower fuel consumption
-timber stays cleaner during yarding
-no bulldozed tractor trails are needed on steep or rough terrain

(1) Although some cable systems offer most of these advantages many offer only a few.

But there may also be the following DISADVANTAGES when compared with tractor logging (2):

-uneconomical for harvesting scattered timber
-more advance planning required for access roads, felling patterns, and log landings
-better quality, all weather access roads needed
-yarding distances limited by terrain or winch drum capacities
-landing space limited to an area under the cables
-a straight logging corridor is often required
-crews must be more skilled and conscientious

(2) These disadvantages apply to many, but not all cable systems.

Planning and Preparing for a Cable Harvest

Sound planning is essential for any successful timber harvest, but is particularly important for cable harvesting.

Step 1

Determine the yarding capabilities of the cable system to be employed and ask the following questions:

-what are the environmental and forest management guidelines for the harvest?
-what is the maximum possible yarding range?
-can the system yard upslope, downslope, or both?
-how does terrain affect practical yarding distances?
-is the system suited to the timber size?
-will a combination of systems be employed?
-in what form will timber be yarded, i.e. whole tree, log length, shortwood?
-in what seasons will the yarding be conducted?
-will timber be stockpiled on the landings (how much and how long)?
-how much landing space will be required for yarding, loading, and hauling equipment?

Step 2

Determine how well the layout and quality of the forest roads in the harvest area suit the capabilities of the yarding system and the criteria established in step 1. If the forest roads are unsatisfactory, the following choices can be made:

-upgrade and/or extend the road network
-relocate the roads if they are poorly situated for yarding, i.e. upslope yarding systems require roads above the harvest area
-clear landings if necessary
-combine yarding systems, i.e. skidders or forwarders can move timber from the cable system landing to a more accessible loading point
-use a more versatile cable system, i.e. standing skylines with long reach and upslope/downslope yarding capabilities
-any combination of the above

When considering these choices, the benefits of a good road system for sustained yield forest management should not be overlooked, nor should the cost of inefficient yarding and hauling.

Step 3

For selective harvests and thinnings, the logging corridors are designated and any tail trees or intermediate support trees marked to save. The timber to be felled may be marked at this time if it was not done previously.

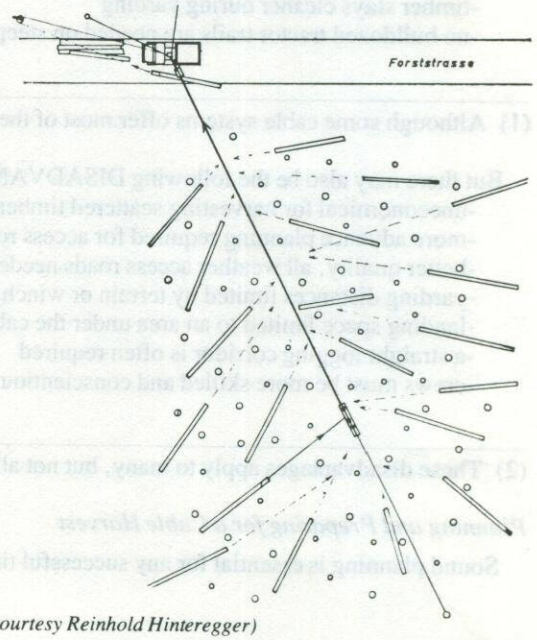
Step 4

Trees are felled in a pattern which minimizes residual stand damage and facilitates yarding.

For selective harvests of log or tree length timber, trees are felled at roughly 45 degree angles to the logging corridor with their butt ends facing the direction of yarding.

For selective harvests of shortwood, 2 meters (6.5 ft.) or less in length, the felling pattern is not important. Usually the shortwood is conveniently bunched into small piles by the cutters, with an entire pile being transported to the landing with each yarding cycle.

For clear cuts being logged by cable systems with no lateral yarding capabilities, the trees are felled at right angles to the logging corridor, thus minimizing the number of times the logging corridor must be changed to reach all the timber.



(Courtesy Reinhold Hinteregger)

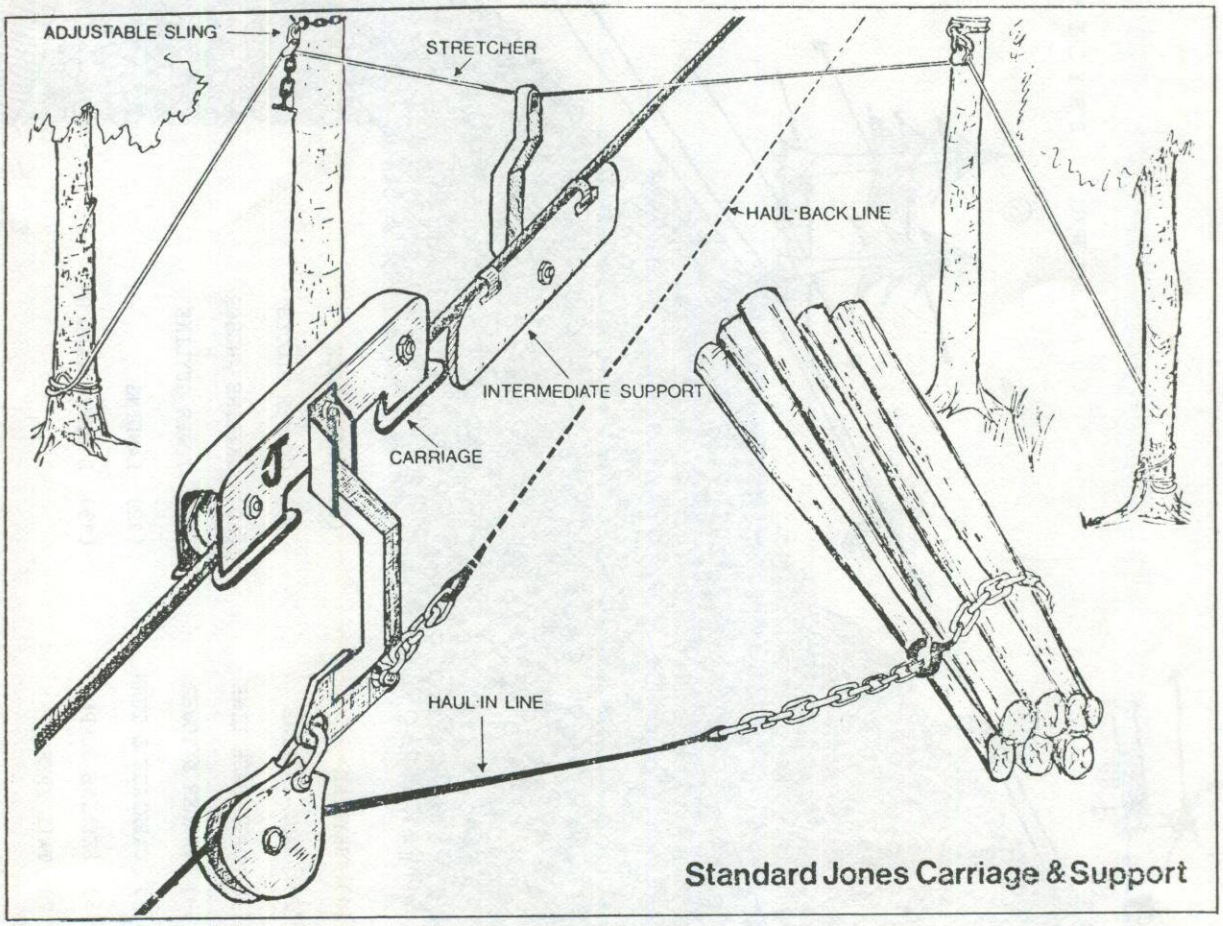
STANDING SKYLINE YARDERS

The standing skyline system is one of the most economical and energy efficient means of yarding timber by cable over varying terrain and moderately long yarding distances (200 - 600 meters).

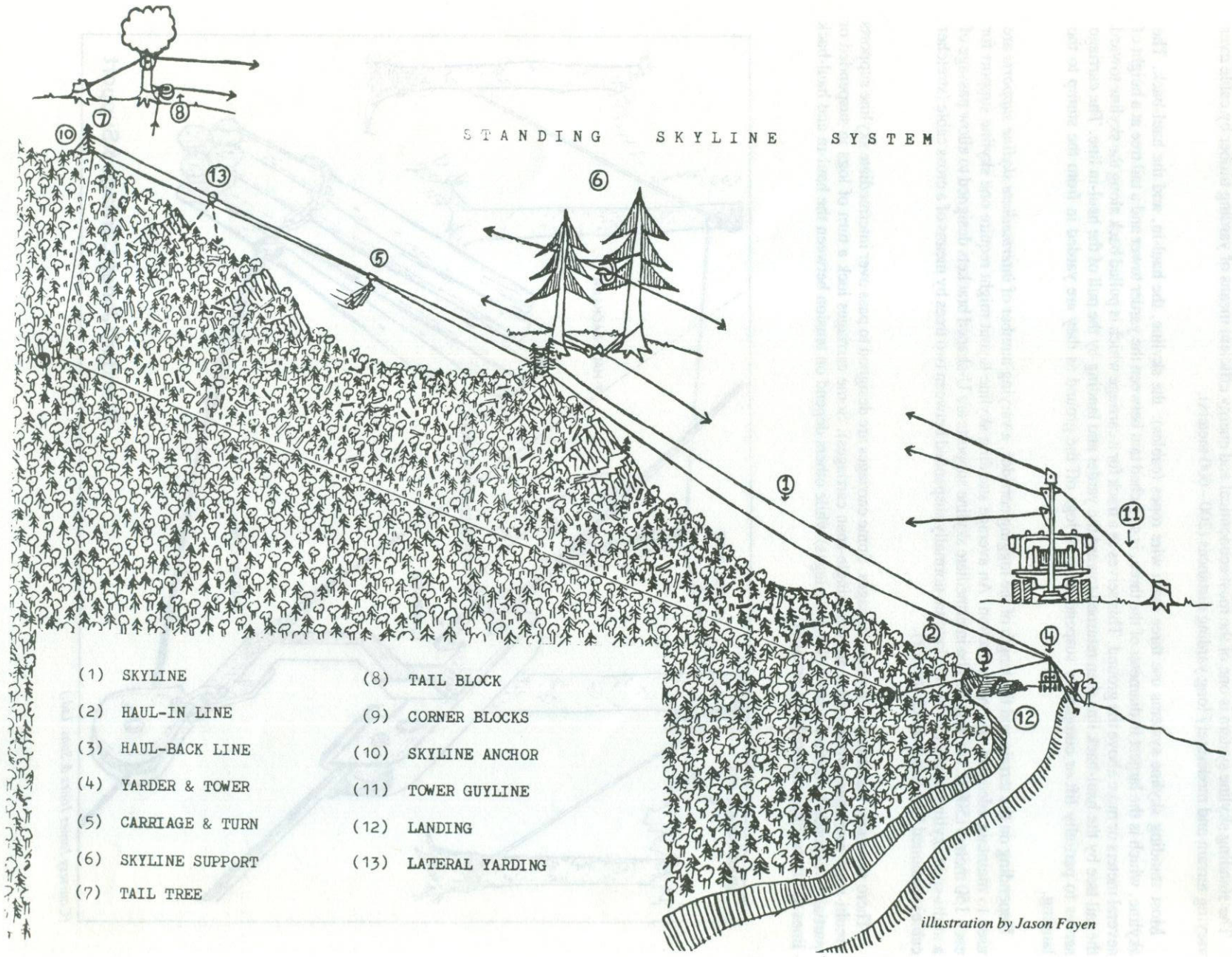
Most standing skyline systems use three main wire ropes (cables): the skyline, the haul-in, and the haul-back. The skyline, which is the largest in diameter of the three, is stretched taut between the yarder tower and a tail tree at a height of several meters or more above the ground. This serves as a track for a carriage which is pulled back along the skyline toward the tail tree by the haul-back line then returned toward the yarder and landing by the pull of the haul-in line. The carriage serves to partially lift or completely suspend turns of logs off the ground as they are yarded in from the stump to the landing.

Depending on the terrain and the length of the logging corridor, a varying number of *intermediate skyline supports* are used to maintain adequate skyline deflection. An average standing skyline layout might require one skyline support for each 150 meters (500 ft.) of length. The intermediate skyline supports are U-shaped brackets designed to allow passage of a multi-span skyline carriage. The brackets are normally suspended between two trees by means of a cross cable (stretcher cable) tensioned by a hand winch (tir-for).

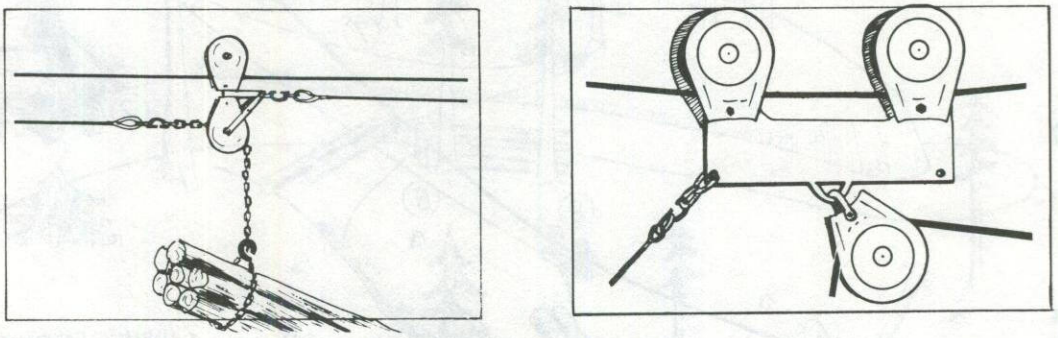
There are many variations of skyline carriages. Some carriages are designed to pass over intermediate skyline supports (multi-span carriages) while others are not (single-span carriages). Some carriages lock a turn of logs in suspended or partially suspended position (load-locking carriages) while others depend on tension between the haul-in and haul-back lines to lift the turn (non-locking carriages).



(Courtesy James Jones & Sons, Ltd.)


STANDING SKYLINE SYSTEM
(1) SKYLINE
(2) HAUL-IN LINE
(3) HAUL-BACK LINE
(4) YARDER & TOWER
(5) CARRIAGE & TURN
(6) SKYLINE SUPPORT
(7) TAIL TREE
(8) TAIL BLOCK
(9) CORNER BLOCKS
(10) SKYLINE ANCHOR
(11) TOWER GUYLINE
(12) LANDING
(13) LATERAL YARDING
illustration by Jason Fayen

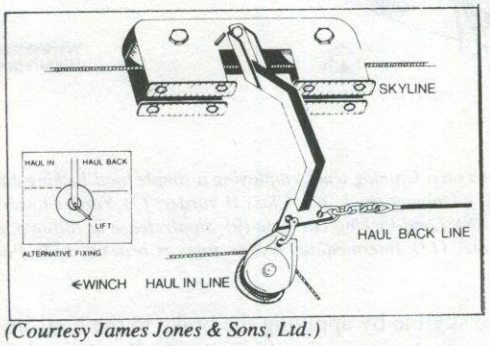
The simplest carriage is the traveling block which is also used on running skylines. It is basically two pulley sheaves fastened together, one above the other. The top sheave rides on the skyline and supports the lower sheave over which the haul-in line passes. The haul-back is fastened to a shackle between the sheaves. The traveling block is not designed to pass over an intermediate skyline support, thus it can only be used on shorter, clear spans (single-span skylines).



(Courtesy James Jones & Sons, Ltd.)

Another simple, single-span carriage uses two pulley sheaves riding on the skyline joined to one sheave below over which the haul-in line passes.

Carriages capable of passing over intermediate skyline supports (multi-span carriages) must have a slot which allows the carriage to pass by the support. The slot must be so designed that the carriage passes the support easily, but does not jump off the skyline.



(Courtesy James Jones & Sons, Ltd.)

A *locking carriage* is similar in basic design to a non-locking carriage except that when a turn is lifted to the carriage by holding the brake on the haul-back and winching in the haul-in line a latching device in the carriage catches and holds the lifting line, thus keeping the load in a suspended position without the necessity of maintaining tension between the haul-in and haul-back lines. This locking feature saves a great deal of wear on the haul-in and haul-back winches' brakes and clutches as well as the wire ropes; less energy is required since the winches are not working against each other; less operator concentration is needed to maintain proper line tensions; and production is increased by 25% or more.

Most load-locking carriages require a stop/release device mounted on the skyline at both the landing and lifting points. The stop/release engages the carriage to hold it in position and simultaneously releases the lock on the lifting line allowing the choker hook to be lowered to the ground. The position of the stop/release at the lifting point is normally changed by a chokerman who moves the anchoring guylines or releases a skyline clamp in the stop/release and slides the device to a new position on the skyline (see illustration on next page).

At least one skyline yarder, the "Smith Timbermaster" employs a carriage which only locks the lifting cable when it is loaded, thus there is no need for a stop release at the lifting point. This enables the carriage to stop anywhere along the skyline to laterally yard and lift a turn without the necessity of repositioning a stop/release device. Only a simple release is required at the landing. Since the "Timbermaster" carriage can pass over the release without stopping, the carriage can be maneuvered after the lifting line has been releasd in the manner of a non-locking carriage for better decking of the logs. (also see "Flemming" Carriage).

The Austrian yarders (Urus & Koller) often use highly sophisticated, self clamping and load-locking carriages for uphill yarding. These carriages are quite heavy and relatively complicated mechanically. Returned to the woods by gravity, they

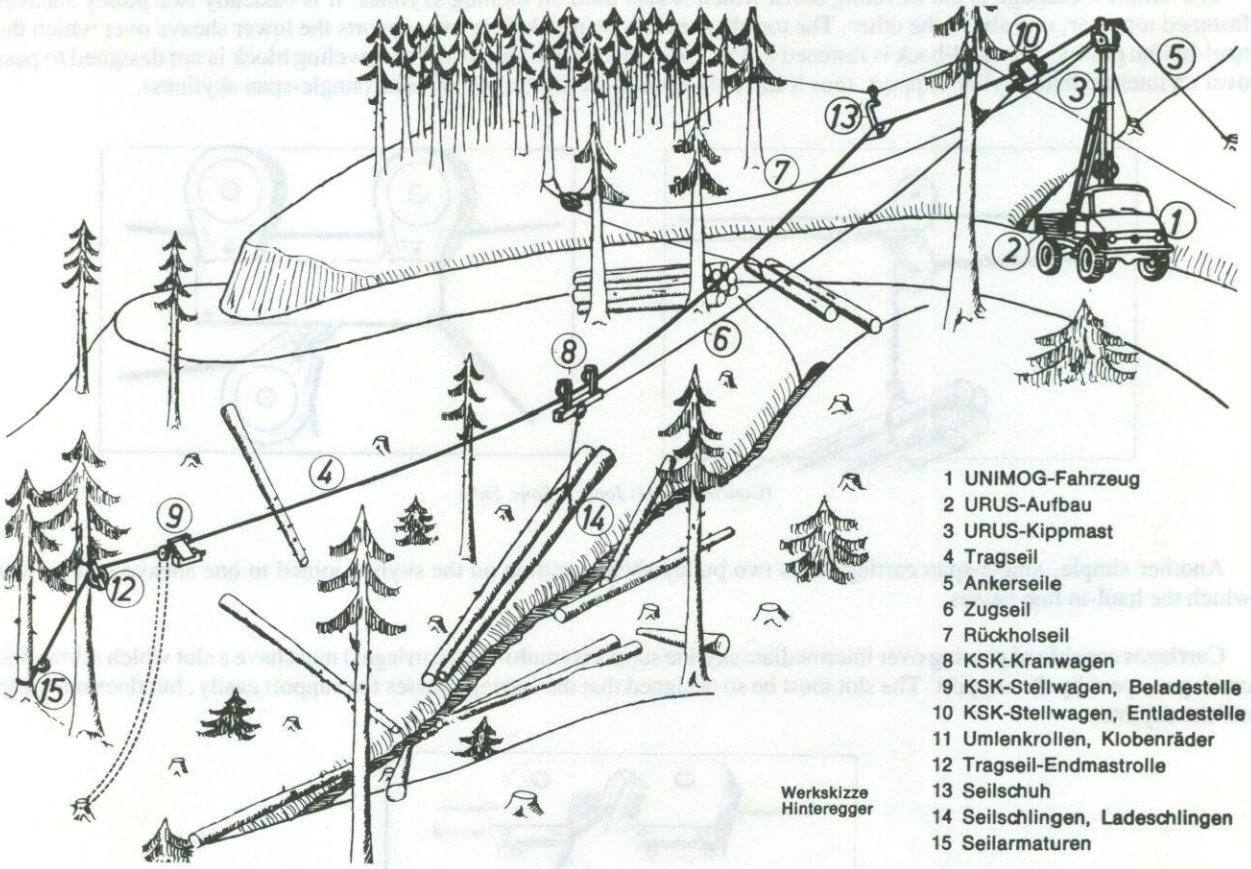


ILLUSTRATION: Urus class II yarder mounted on a Unimog truck employing a simple load-locking carriage and using gravity outhaul to return the carriage to the woods. KEY to illustration: (1) Unimog truck, (2) Class II yarder, (3) Yarder tower, (4) Skyline, (5) Guyline, (6) Haul-in line, (7) Haul-back line used to clear the landing, (8) Load-locking carriage (9) Stop/release at lifting point, (10) Stop/release at landing, (11) Angle change block for haul-back line, (12) Tail tree, (13) Intermediate skyline support bracket, (14) Partially suspended turn, (15) Skyline anchor. (Courtesy Reinhold Hinteregger)

are stopped at the desired point on the skyline by applying the brake to the haul-in. Once a carriage has been stopped it automatically clamps itself to the skyline and releases the choker hook allowing the lift line to lower it to the ground. These carriages are often used on skyline cranes and require a slope of 15% or more for operation since they return by gravity. (see Hinteregger/Urus Carriages in Skyline Crane section)

All carriages used with standing skyline systems have lateral yarding capabilities. On most skyline carriages the haul-in line runs through the carriage and serves as the *lateral yarding* cable, thus as much of the haul-in cable may be pulled through the carriage as is needed. The practical limits to lateral yarding are usually 25 to 50 meters (80 to 160 ft.) on each side of the skyline and are determined by the following factors:

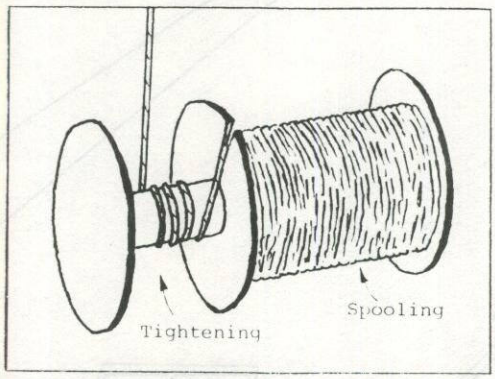
-weight of the haul-in line being pulled by the chokerman
-height of the skyline above the terrain, i.e. the higher the skyline the more lift there is on laterally yarded turns, thus reducing chances of hang-ups.
-density of the residual stand
-length and size of logs
-ground conditions which hinder the chokerman, i.e. steep slope, snow, slash, etc.

On the far end of a long setting it becomes difficult for a lone chokerman to pull out the haul-in line for lateral yarding since he must pull the entire weight of the haul-in, as much as 600 meters (2000 ft.) of wire rope. The larger the yarder and the heavier the wire ropes, the worse this problem becomes. Extra chokermen may be added to assist in pulling slack, but labor costs prohibit this as a regular practice.

At least two of the skyline yarders, the ''Timbermaster'' and the ''Highland Trailer Alp'' can be equipped with *slack pulling* winch drums. The wire rope from the slack pulling drum on the yarder is connected to a small slack pulling drum on the carriage and runs parallel to the haul-in line. When slack is desired for lateral yarding, the slack pulling line is winched in turning the drum in the carriage which feeds out the haul-in line or a separate lifting line to the chokerman.

In principle any style carriage may be used with any make of standing skyline yarder, but carriage size must correspond with yarder and wire rope sizes. Also rigging of the skyline must be done to suit the style of carriage, thus it is the safest practice to use a carriage recommended by the yarder manufacturer.

Since most standing skyline systems use three main wire ropes, nearly all standing skyline yarders have at least three *winch drums*. The largest drum stores and tensions the skyline. On several yarders this drum is divided into a storage section and a tensioning section, to eliminate the problem of crushing and binding the stored line when the skyline is tensioned.



(Courtesy New Zealand Logging Industry Research Association)

Two high speed winches serve the haul-back line and haul-in lines, with maximum line speeds approaching 400 meters per minute (1300 fpm). Since the haul-back line must be twice as long as the haul-in line, at least two makes of yarders, "Timbermaster" and "Urus", have a haul-back drum double the capacity of the haul-in drum. The other yarders with equal sized drums must use a smaller diameter haul-back if the full working range of the yarder is to be realized.

Yarders may also be equipped with a strawline drum, a slack pulling drum, and up to four small guyline storage and tensioning drums.

Virtually all the standing skyline yarders used in industrialized countries where labor costs are high, have their own *towers* that can be lowered and erected quickly each time the yarder is moved. This saves the time consuming task of rigging a new spar tree each time.

The metal towers are of varying designs, but all are equipped with fairleads (or blocks) near the top for the haul-in, haul-back, and the skyline.

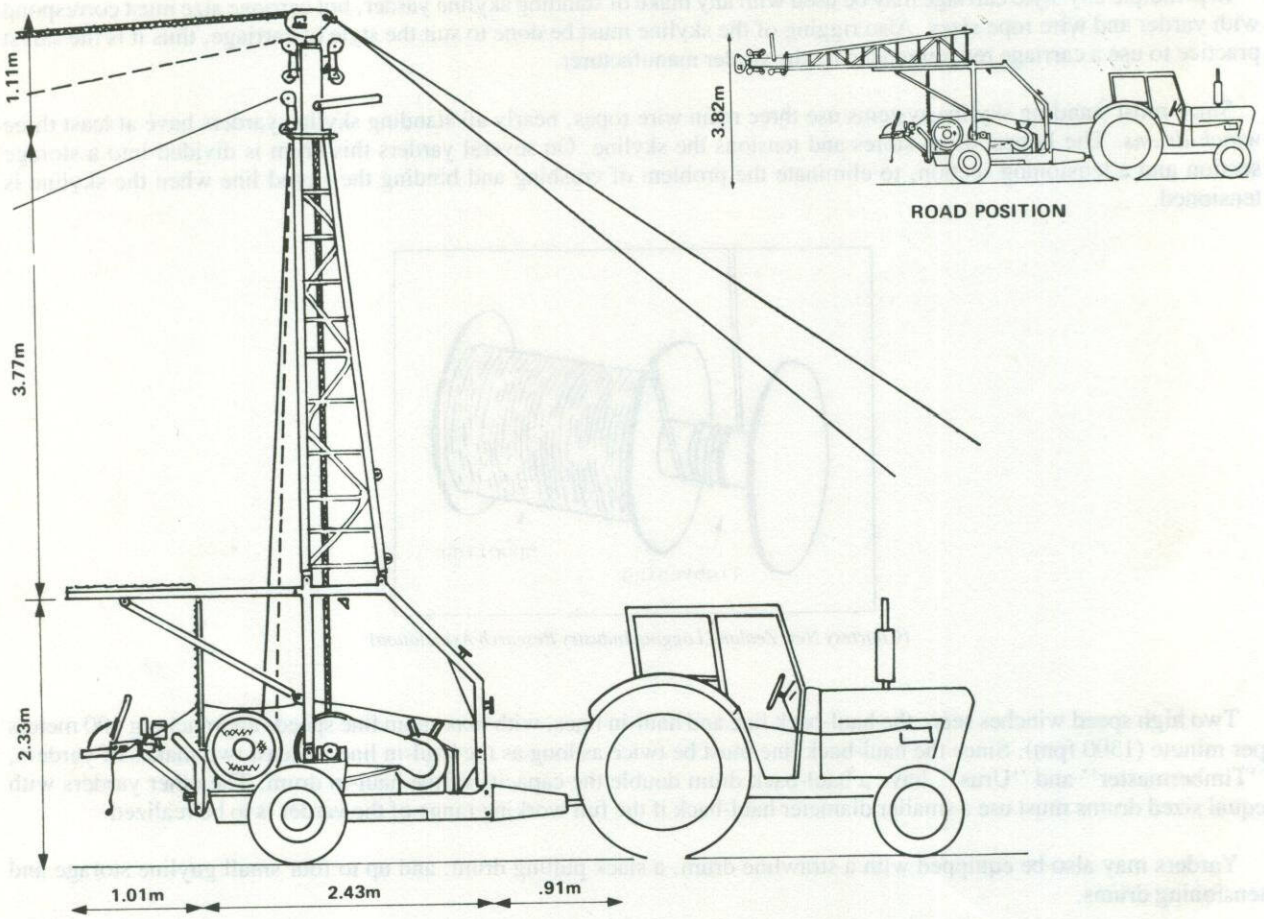
Set-up of a typical standing skyline system is as follows:

Setting-up the Yarder

-the yarder is positioned at the far edge of the forest road or landing area
-the tower is raised
-the tower guylines are pulled out, attached to suitable anchors (usually stumps or trees) and tensioned

Laying out the Lines

-corner blocks are hung at the back of the setting and where needed to change the direction of the haul-back line
-the strawline is pulled down the logging corridor, through the corner blocks, and back to the yarder
-the haul-back is fastened to the end of the strawline and is pulled around the setting until the strawline is entirely winched in and the haul-back makes a complete loop around the setting and back to the yarder
-if the yarder is not equipped with a strawline drum, the haul-back line must be pulled around the setting mannually or with a small portable winch
-the haul-back is unhooked from the strawline and attached to the end of the skyline
-the haul-back is winched in, pulling the skyline to the end of the logging corridor
-the skyline is passed through a block hung several meters up the tail tree and is guyed back to the base of a second tree (for the larger systems additional guylines are fastened to the tail tree)
-if needed, one or more skyline supports are rigged along the logging corridor
-the strawline is again pulled out along the logging corridor and attached to the end of the haul-back which was



(Courtesy James Jones & Sons, Ltd.)

unhooked from the skyline at the tail tree
-the strawline is winched in, pulling the haul-back along the logging corridor to the yarder so that it again makes a complete loop around the setting
-the carriage and any stop/release devices are hung on the skyline and the haul-back is attached to the tail tree side of the carriage
-the haul-in line is fed through the carriage from the yarder side
-the skyline is tensioned and the system is ready for operation

Set-up times for standing skyline systems usually vary directly with yarder size, i.e. heavier cables and components. Terrain, yarding distance, and cutting methods (clearcut, selective, or thinning) also affect set-up times.

Yarders such as the "Timbermaster" and the "Highland Trailer Alp" require from 1 to 2 hours for an experienced two man crew to take down, move, and set-up again on an average 300 meter (1000 ft.) setting. Larger yarders such as the Urus Class IV or the Koller 800 may take 3 or 4 men twice as long for a similar take down and set up.

The *yarding sequence* for a standing skyline system is generally as follows:
-the haul-back line pulls the carriage into the woods
-the chokerman signals the yarder operator by radio (walkie-talkie) to stop the carriage
-the choker drops down from the carriage on the end of the haul-in or lift line
-the chokerman pulls out the line from the carriage and attaches it to one or more logs
-the chokerman signals the yarder operator by radio to winch in the haul-in line pulling the logs to the carriage
-the brake pressure is eased off the haul-back and the haul-in pulls the carriage toward the landing with the turn of logs partially or completely suspended underneath
-at the landing the suspended turn is lowered to the ground by slacking the haul-in line and is unhooked by the yarder operator or chaser
-if the lift line is fitted with a "Flemming" quick release hook, the turns are automatically unchokered when lowered to the ground
-the yarding cycle is repeated

Other rigging configurations such as highlead, running skyline, and gravity outhaul may be used with standing skyline yarders. The standard highlead system is seldom employed (see Highlead section).

For short yarding distances of 150 meters (500 ft.) or less, the *running skyline* is very quick and easy to set up (10-30 minutes). Only the haul-back and haul-in lines are employed and a running block is generally used for the carriage (see page 3). The "Highland Trailer Alp" is often rigged in this fashion.

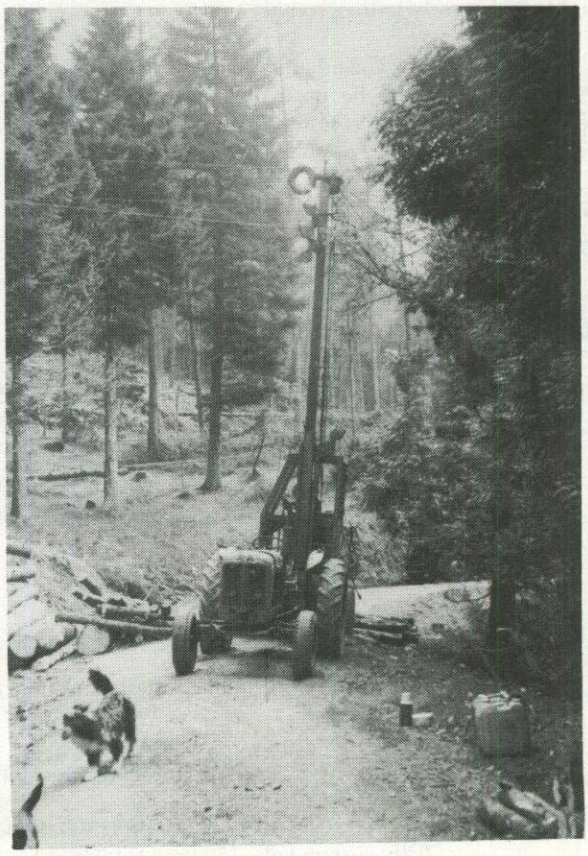
Virtually any yarder with two or more winch drums can be rigged in combination with a heavy skyline carriage as a *gravity outhaul system*. On slopes exceeding 15% the skyline carriage makes a freewheeling return to the woods, slowed only by the brakes on the haul-in drum which winches the carriage and turn back, upslope to the landing. Since a haul-back line is not employed there is a savings in rigging time, cable wear, and return time for the empty carriage (see illustration on page 4 of a gravity outhaul system).

The "Urus" and "Koller" yarders described in this section are often rigged for gravity outhaul. If a yarder does not have a skyline drum, i.e. double drum yarder, the haul-in line may be used as a skyline and the haul-back line used as the haul-in.

SMITH TIMBERMASTER

The "Timbermaster", designed and manufactured by a small agricultural engineering firm in Scotland, is a well engineered machine of rugged yet compact design. The unit is trailer mounted for ease of movement and is powered by a standard farm tractor.

Two operators are required for the "Timbermaster", one to run the yarder and one to set chokers. The yarder operator runs the system with two hand levers, one for the mainline winch and one for the haul-back winch. Throttle speed is controlled by a foot pedal with a control cable leading to the farm tractor power unit. If a self-releasing choker hook is used the yarder operator does not have to double as chaser and the turns can be quickly dropped at the landing allowing the skyline carriage to return to the woods without delay. Communications between the choker setter and yarder operator are by radio.



Transportation and set up of the "Timbermaster" is fast and easy. The farm tractor power unit pulls the yarder from site to site. The 24 ft. (7.3 meter) tower is quickly raised from the horizontal transport position to the vertical operating position by a hydraulic cylinder powered from the tractor hydraulics. Three guylines are used to stabilize the tower, then the main cables are pulled into position using the polypropylene strawline and the strawline drum. An average move and set up of a 1000 ft. (300 meter) skyline road generally takes two men slightly over one hour.

Residual stand damage and soil disturbance is very low since the "Timbermaster" uses a locking skyline carriage which holds the loads well off the ground during transport to the landing. The locking carriage also greatly increases the fuel efficiency of the system and reduces cable and brake wear since the haul-back and mainline (haul-in) do not have to work against each other to hold the load off the ground.

Terrain, soil conditions, and weather have little effect on the operation of the "Timbermaster". Since the carriage is powered back to the woods by the haul-back line and powered to the landing by the haul-in line it is not dependent on gravity for movement in either direction, but gravity can still be used to significantly reduce the energy inputs required. Since carriage movement is not dependent on gravity, upslope, downslope, or level skyline settings can be easily yarded. Ground conditions also have little effect since the carriage travels on an overhead cable. Snow, mud, rocks, etc. only slow the system's operation when they become a hinderance to the chokerman.

The operating range of the "Timbermaster" can extend up to 2000 ft. (600 meters) thus giving the potential of working a 4000 ft. (1200 meters) wide strip from a single access road. For long distance yarding or yarding over broken terrain, intermediate skyline supports are used. A unique high speed haul-back winch returns the carriage to the woods at speeds up to 1200 fpm (365 meters/minute). Speeds on the haul-in may reach 800 fpm (240 meters/minute) with a maximum 2 ton line pull. Compared with the line pull developed by skidder winches this may not seem like much, but the lifting effect on the skyline compensates for the power differential and results in much less residual stand damage.

The design of the "Timbermaster" incorporates many features for the safety of the operator. A sturdy, shielded, operator's cab is positioned for good visability of the landing and logging corridor. The simple controls cut operator mistakes to a minimum. The self releasing choker hook eliminates the need for the operator to leave the machine to unhook logs on the landing. In the rare case of a carriage runaway there is an emergency skyline release which drops the carriage and load instantly to the ground.

In July 1978, the Canadian Forest Service imported a "Timbermaster" into Newfoundland for testing. This is the first "Timbermaster" to be used in North America. Several other cable logging systems have already been tested in Newfoundland, but it is felt the "Timbermaster" is better suited to their timber and terrain than any that have been tried previously.

General Data - "Smith Timbermaster"

Operating range: with 9 mm (⅜") wire ropes - 450 meters (1500 ft.)
with 8 mm (5/16") wire ropes - 600 meters (2000 ft.)

Winch drum capacities:
Haul-in: with 9 mm (⅜") wire rope - 450 meters (1500 ft.)
with 8 mm (5/16") wire rope - 600 meters (2000 ft.)
Haul-back: with 9 mm (⅜") wire rope - 900 meters (3000 ft.)
with 8 mm (5/16") wire rope - 1200 meters (4000 ft.)
Skyline: with 13 mm (½") wire rope - 600 meters (2000 ft.)
Strawline: with 6 mm (¼") polypropylene rope - 1200 meters

Line speeds:
Haul-in: 0-250 meters/minute (820 fpm)
Haul-back: 0-380 meters/minute (1250 fpm)

Line speed & power control: throttle & interchangeable chain sprocket drives

Line pull:
Haul-in: with 8 mm (5/16") wire rope - 2000 kg. (4400 lbs.)

Load capacity: one end suspended - 1500 kg. 3300 lbs.)
fully suspended - 750 kg. (1600 lbs.)

Guylines: 3-13 mm (½") X 40 meters (130 ft.)

Tower:
Height: 24 ft. (7.3 meters)
Construction: Single, box steel mast
Erection: hydraulic

Weight: not available

Controls: Excellent
Winch clutches & brakes: hydraulic
Throttle: foot pedal with control cable to tractor

Operator visability:
Of landing: excellent
Of winch drums: excellent

Operator protection: excellent

Minimum crew size: 1 yarder operator
1 chokerman

Power source: from the PTO of a 50-75 hp. (37-56 kW) farm tractor

Mounting: trailer

Standard skyline carriage: load-locking, multi-span

Special features: epicyclic haul-back clutch

Cost of system (1978): $30,000 delivered to New York or Boston

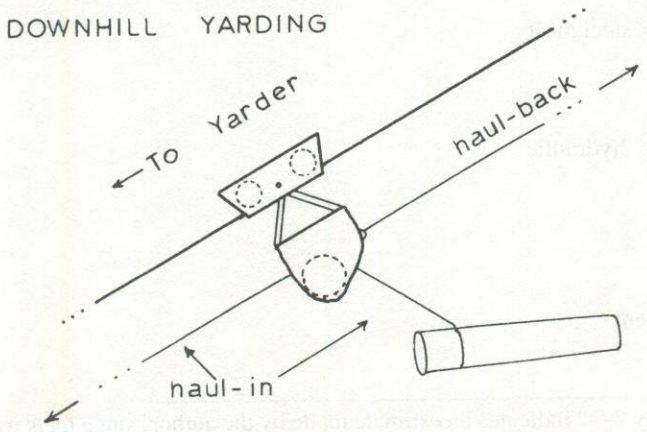
Optional equipment: self releasing choker hook

Additional equipment needed for operation:
Farm tractor
Radio communications system
Wire ropes

Manufacturer: G.R. Smith (Engineers), Ltd.
Acharn, by Aberfeldy
Perthshire, PH15 2HS
Scotland, United Kingdom

FLEMMING LOCKING CARRIAGE

The "Flemming" locking carriage is very similar in operation and design to the load-locking carriage used with the "Timbermaster" yarder. The carriage is susupended beneath two sheaves which run on the skyline. For upslope yarding



the haul-in rope holds the carriage in position and the haul-back passes through the carriage for lateral yarding. In downslope yarding the haul-back holds the carriage and the haul-in passes through it for lateral yarding. The automatic load locking device only operates when a predetermined load is on the choker hook, thus eliminating the need for a carriage stop/release at the lifting point.

Use of a load-locking carriage vs. a non-locking carriage may increase production by as much as 25%. Also there is less wear on the entire system and less fatigue for the operator since a constant tension need not be maintained between the haul-in and haul-back lines.

A self releasing choker hood manufactured by Chieftan Forge (''Flemming'' hook) and used with the ''Timbermaster'' system cuts turn around time, operator fatigue, and labor requirements to a minimum at the landing.
Manufacturer: Chieftan Forge, Ltd.
Burnside Road
Bathgate, West Lothian
Scotland, United Kingdom
EH48 4PU

TIMBERMASTER SKYLINE HAULER

The ''Timbermaster Skyline Hauler'' manufactured and used in Australia and New Zealand, is a modified version of the ''Timbermaster'' from Scotland.

This unit offers the optional mounting of a Swedish Cranab 5000 hydraulic knuckle-boom loader on top of the operators cab. Although the loader is useful in maintaining a clear landing, especially in upslope yarding, it adds considerably to the cost of the unit and can interfere with the yarding cycle.

In contrast to the Scottish ''Timbermaster'', this machine is powered by its own engine and must be mounted on a suitable carrier, be it either a truck bed or trailer. The heavier construction of the ''Timbermaster Skyline Hauler'', the self-power unit, and the optional loader make this yarder much heavier which can cause problems when moving the unit on steep road gradients, and/or soft ground conditions.

General Data - ''Timbermaster Skyline Hauler''

Operating range: with 9 mm (⅜'') wire ropes - 350 meters (1150 ft.)

Winch drum capacities:
Haul-in: with 9 mm (⅜'') wire rope - 400 meters (1300 ft.)
Haul-back: with 9 mm (⅜'') wire rope - 700 meters (2300 ft.)
Skyline: with 13 mm (½'') wire rope - 450 meters (1500 ft.)
Strawline: with 10 mm (⅜'') polypropylene rope - over 700 meters (2300 ft.)

Maximum line pull:
Haul-in: 4000 kg. (9000 lbs.)

Guylines: 3

Tower:
Height: 7.6 meters (25 ft.)
Construction: single, box steel mast
Erection: ?hydraulic?*

Controls: cramped
Winch clutches & brakes: hydraulic

Operator visability:
Of landing: good
Of winch drums: fair

Operator protection: excellent

*information bracketed by ?—? indicates an estimate made by the author, since facts were not available

Minimum crew size: 1 yarder operator
1 chokerman
1 chaser (optional)

Power source: self-contained 69 hp. (51 kW) diesel

Mounting: not supplied - purchasers choice of truck bed, trailer, etc.

Cost of system (1976): $43,000 purchased in New Zealand, less wire ropes

Optional equipment: Locking carriage
self releasing choker hook

Additional equipment needed for operation:
Mounting on suitable carrier
Radio communications system
Wire ropes

Distributor (New Zealand):
Morbark Pacific, Ltd.
Rotorua, New Zealand

HIGHLAND TRAILER ALP

The "Highland Trailer Alp" is a blend of Scottish (James Jones & Sons, Ltd.) and Norwegian (Igland) engineering skills. This machine is trailer mounted and uses a standard 50 to 75 hp. (37-56 kW) farm tractor for power. The tower is of lattice steel construction, rising nearly 24 feet (7.3 meters) above the ground. For the haul-in and haul-back, the "Highland Trailer Alp" uses a double drum winch unit which is a modified version of Igland winches used on tractor-mounted, double-drum ground skidding/skyline units. The operator stands on the ground at the rear of the yarder, under a wire mesh protective canopy (see illustration on page 6).

(Courtesy James Jones & Sons, Ltd.)

There are now several ''Highland Trailer Alp'' units being used on thinning operations in the Pacific Northwest.

General Data - ''Highland Trailer Alp''

Operating range: with 11 mm (7/16'') wire ropes - 225 meters (750 ft.)
with 9 mm (⅜'') wire ropes - 325 meters (1050 ft.)
with ? 7 mm (9/32'')? wire rope on haul-back drum - 600 meters (2000 ft.)

Winch drum capacities:
Haul-in: with 11 mm (7/16'') wire rope - 450 meters (1500 ft.)
with 9 mm (⅜'') wire rope - 650 meters (2100 ft.)
Haul-back: same wire rope capacity as haul-in
Skyline: with 18 mm (11/16'') wire rope - 800 meters (2600 ft.)
Strawline: with 3 mm (⅛'') wire rope - 1300 meters (4300 ft.)
Erection & yarding: with 11 mm (7/16'') wire rope - 90 meters (300 ft.)

Line speeds:
Haul-in: 0-275 meters/minute (900 fpm)
Haul-back: 0-275 meters/minute (900 fpm)

Line speed & power control: throttle & choice of gear reductions

Maximum line pull: not available

Guylines: 3

Tower:
Height: 7.2 meters (24 ft.)
Construction: lattice steel
Erection: cable

Weight: without wire rope - 2500 kg. (5500 lbs.)
with wire rope - 4200 kg. (9200 lbs.)

Controls: Good
Winch clutches & brakes: hydraulic
Throttle: hand operated or foot pedal with control cable to farm tractor power unit

Operator visability:
Of landing: good
Of winch drums: excellent

Operator protection: good

Minimum crew size: 1 yarder operator
1 choker setter

Power source: 50-75 hp. (37-56 kW) farm tractor

Mounting: trailer

Standard Skyline carriage: non-locking (see illustration on page 1)

Cost of system (1978): $50,000-$60,000 less wire ropes

Optional equipment:
self releasing choker hook
slack pulling drum
locking carriage or ''Alp Cat'' carriage with power doubling lifting drum (note carriage in photo on page 11)

Additional equipment needed for operation:
farm tractor
wire ropes
radio communications system

Manufacturer: James Jones & Sons, Ltd.
Service Division
Broomage Avenue
Larbert, Stirlingshire
Scotland, United Kingdom
FK5 4NQ

Remarks: James Jones & Sons, Ltd. is a large company which manufactures and sells a wide range of logging equipment

IGLAND "ALP WINCH"

Per Iglands Fabrikk A/S of Norway, manufacturer of the winches used on the Igland-Jones "Highland Trailer Alp" offers a trailer mounted tower and winch unit similar to the "Highland Trailer Alp", but simpler in design. The same haul-in and haul-back winches are used, but the tower is less sophisticated, and no protective canopy is provided for the operator.

A simple running block (see the first illustration on page 3) carriage is used for short distance yarding. For longer distances and heavier loads, an "Alp Cat" carriage is used. A three part drum on the carriage with a 4:2:1 ratio is activated by reverse rotation of the haul-in and haul-back winches and serves to double the line pull of the lifting line over that of the haul-in. The carriage is non-locking and requires a stop on the skyline to hold it at the lifting point. (see the carriage in the photo on page 11)

Cost of yarder: $30,000-$35,000 (1978 estimated price)

U.S. Importer: Indag Iowa, Inc.
P.O. Box 1227
Spencer, Iowa 51301

Manufacturer: Per Iglands Fabrikk A/S
4890
Grimstad, Norway

MINI URUS - CLASS I

With a tower height of only 15 feet (4.6 meters), and a power input of 25-40 hp. (18.5-30 kW), the "Mini Urus" is the smallest of the skyline yarders. This trailer mounted unit is powered by its own engine, can be easily towed between yarding locations, and is quickly erected.

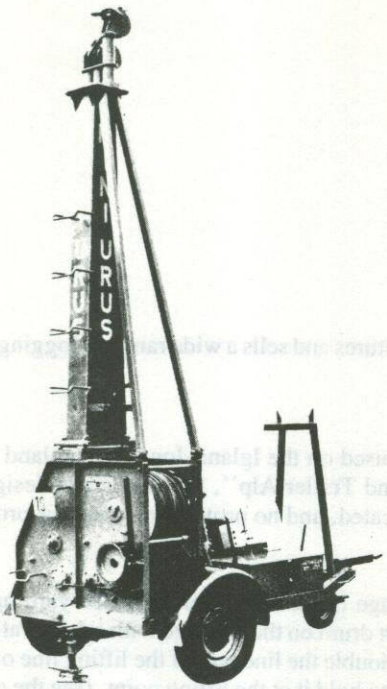
Because of its small size and economy of design, the "Mini Urus" lacks some of the convenient features of the larger machines. The operator stands on the ground behind the machine to operate the manual controls placed on both sides of the tower and winch drums. Downhill logging with the "Mini Urus" is more difficult than uphill since the controls are not well grouped and both the haul-back and haul-in winches must be operated simultaneously.

The lifting line on the "Mini Urus" skyline carriage is doubled through a fall block to which the choker hook is attached. This line arrangement doubles the lateral yarding and lift pull over that of the haul-in, but it also makes it more difficult for the chokerman to pull the fall block and double line for lateral yarding.

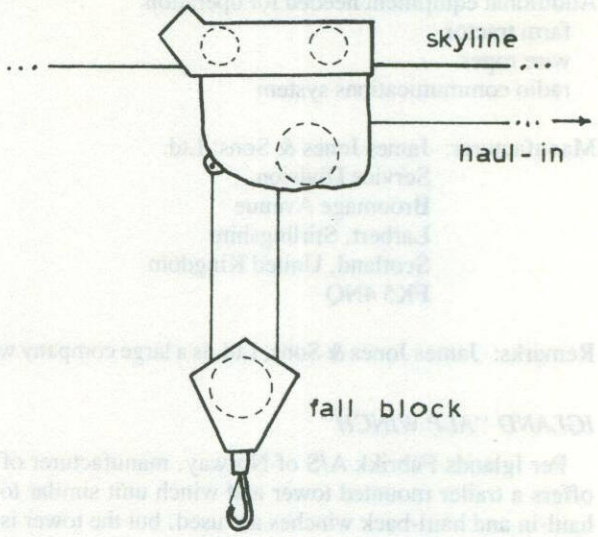
General Data - Mini Urus

Operating range: with 11 mm (7/16") skyline - 400 meters (1300 ft.)
with 13 mm (½") skyline - 300 meters (1000 ft.)

Winch drum capacities:
Haul-in: with 6.5 mm (¼") wire rope - ? 400 meters (1300 ft.)?
Haul-back: with 6.5 mm (¼") wire rope - ? 800 meters (2600 ft.)?
Skyline: with 13 mm (½") wire rope - 300 meters (1000 ft.)
with 11 mm (7/16") wire rope - 400 meters (1300 ft.)
Strawline: none



(Courtesy Reinhold Hinteregger)



Line speeds: not available

Line speed & power control: throttle & 4-speed gear box

Load capacity: with 11 mm (7/16'') skyline and 6.5 mm (¼'')
haul-in & haul-back
fully suspended - 600 kg. (1300 lbs.)
one end suspended - 1000 kg. (2200 lbs.)
with 13 mm (½'') skyline and 8 mm (5/16'')
haul-in
fully suspended - 800 kg. (1800 lbs.)
one end suspended - 1400 kg. (3100 lbs.)

Guylines: 1 main - 12 mm (15/32'')
1 safety - 10 mm (13/32'')

Tower:
Height: 4.7 meters (15 feet)
Construction: single, box steel mast with braces
Erection: threaded spindle or hydraulic

Weight:
Yarder with wire ropes: 1800 kg. (4000 lbs.)
Skyline carriage & rigging hardware: 400 kg. (880 lbs.)

Controls: Fair - on both sides of winch drums & tower
Winch clutches & brakes: ?manual?
Throttle: ?hand friction?

Operator visability:
Of landing: fair - stands behind tower
Of winch drums: good

Operator protection: fair - machine is between incoming logs & operator

Minimum size crew: 1 yard operator
1 chokerman

Power source: 25-40 hp. (19-30 kW) self contained engine

Mounting: trailer

Standard skyline carriage: non-locking, power doubling lifting block, skyline stops required

Cost of system: available from manufacturer

Optional features: hydrostatic drive

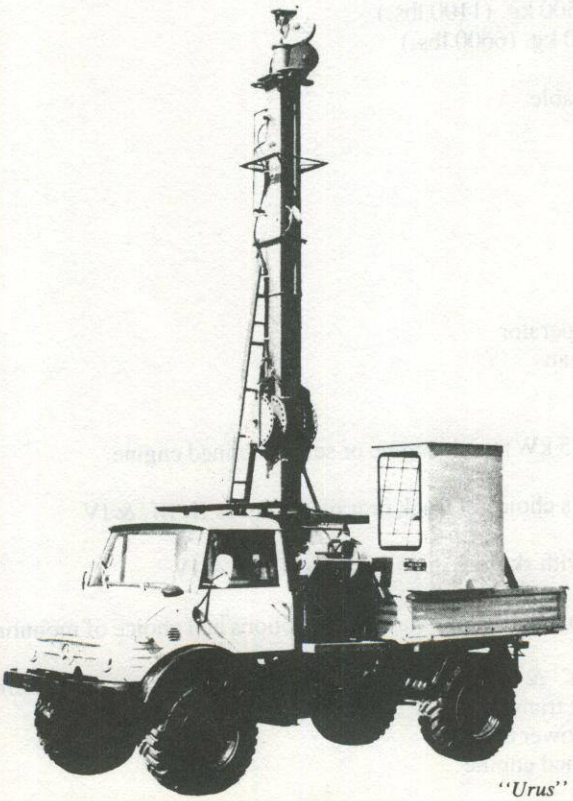
Additional equipment needed for operation:
Radio communications system
Vehicle for towing

Manufacturer: Reinhold Hinteregger
Maschinen-und Seilbahnbau
Zehenthofstr. 33, Postfach 42
A-9500 Villach, Austria

URUS YARDERS - CLASSES II, III, & IV

In addition to the "Mini Urus" three larger models of skyline yarders are manufactured by Reinhold Hinteregger. Often these units are mounted on Mercedes-Benz, 4-wheel-drive trucks, but they can also be mounted on carriers such as used trucks or trailers. Power is supplied either by the truck engine or by the yarder's own engine with a choice of manual or hydrostatic transmissions.

Although all the "Urus" skyline systems can be operated by a minimum 2 man crew, a chaser working with the class II - IV yarders eliminates delays caused by the yarder operator climbing down from the cab to unhook turns on the landing. Also an extra chokerman speeds the handling of the heavier lines when hooking turns for the class IV yarder ("Urus Gigant").



"Urus" class II. (Courtesy Reinhold Hinteregger)

General Data - "Urus" class II

Operating range: with 20 mm (13/16") skyline - 400 meters (1300 ft.)
with 16 mm (⅝") skyline - 600 meters (2000 ft.)

Winch drum capacities:
Haul-in: with 11 mm (7/16") wire rope - 400 meters (1300 ft.)
with 9 mm (⅜") wire rope - 600 meters (2000 ft.)
Haul-back: with 11 mm (7/16") wire rope - 800 meters (2600 ft.)?
with 9 mm (⅜") wire rope - ? 1200 meters (4000 ft.)?
Skyline: same as operating range
Strawline: with 5.5 mm (7/32") wire rope - ? 1200 meters (4000 ft.)?

Line speeds: not available - classes II - IV

Line speed & power control: throttle and manual or hydrostatic transmission

Load capacity: with 20 mm skyline & 11 mm haul-in & haul-back lines -
Fully suspended - 2000 kg. (4400 lbs.)
Partially suspended - 3000 kg. (6600 lbs.)
with 16 mm skyline & 9 mm haul-in & haul-back lines -
Fully suspended - 1000 kg. (2200 lbs.)
Partially suspended - 1500 kg. (3300 lbs.)

Guylines: 1 main - 16 to 18 mm (⅝ to 23/32")
1 safety - 14 to 16 mm (9/16 to ⅝")

Tower:
Height: 7 meters (23 ft.)
Construction: single, box steel mast with braces
Erection: threaded spindle or hydraulic

Weight:
Yarder with wire ropes: 3600 kg. (8000 lbs.)
Skyline carriage & rigging: 500 kg. (1100 lbs.)
Minimum truck weight: 3000 kg. (6600 lbs.)

Controls: information not available

Operator visability:
Of landing: good
Of winch drums: ? fair?

Operator protection: good

Minimum crew size: 1 yarder operator
1 chokerman
1 chaser

Power source: 50-100 hp. (37-75 kW) truck engine or self-contained engine

Mounting: optional - purchaser's choice of truck or trailer -classes II, III, & IV

Skyline carriage: load locking with skyline stops - classes II, III, & IV

Cost of system: available from manufacture - varies with options and choice of mountings and carriages

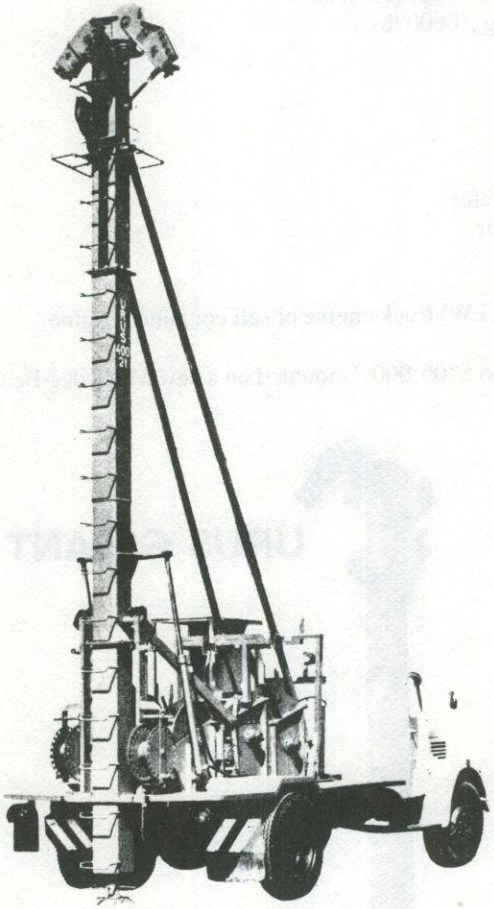
Optional equipment: "Gravimat" & "Tricamat" carriages (see Hinteregger/Urus Carriages in skyline crane section)
hydrostatic transmission
hydraulic tower erection
self contained engine

Additional equipment needed for operation:
Radio communications system
Truck or trailer mounting

Manufacturer: Reinhold Hinteregger

Remarks: Reinhold Hinteregger is a large company which has been supplying skyline logging equipment for worldwide use for over 30 years.

General Data - ''Urus'' class III



(Courtesy Reinhold Hinteregger)

Operating range: with 22 mm (⅞'') skyline - 400 meters (1300 ft.)
with 18 mm (23/32'') skyline - 600 meters (2000 ft.)

Winch drum capacities:
Haul-in: with 12 mm (15/32'') wire rope - 400 meters (1300 ft.)
with 10 mm (13/32'') wire rope - 600 meters (2000 ft.)
Haul-back: with 12 mm wire rope - ?800 meters (2600 ft.)?
with 10 mm wire rope - ?1200 meters (4000 ft.)?
Skyline: same as operating range
Strawline: with 5.5 mm (7/32'') wire rope - ?1200 meters (4000 ft.)?

Load capacity: with 22 mm skyline & 12 mm haul-in & haul-back lines
Fully suspended: 2500 kg. (5500 lbs.)
Partially suspended: 4000kg. (8800 lbs.)
with 18 mm skyline & 10 mm haul-in & haul-back lines
Fully suspended: 1500 kg. (3300 lbs.)
Partially suspended: 2500 kg. (5500 lbs.)

Guylines: 1 main - 16 to 20 mm (⅝ to 25/32'')
1 safety - 16 to 18 mm (⅝ to 23/32'')

Tower:
Height: 8.7 meters (28 ft.)
Construction: single, box steel mast with braces
Erection: threaded spindle or hydraulic

Weight:
Yarder with wire ropes: 6000 kg. (13,200 lbs.)
Carriage and rigging hardware: 600 kg. (1320 lbs.)
Minimum truck weight: 3000 kg. (6600 lbs.)

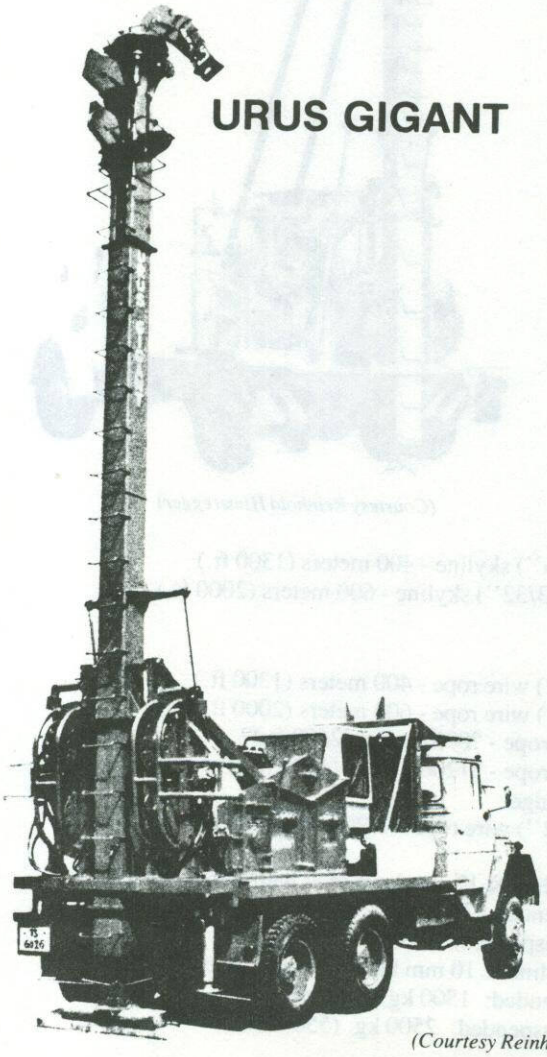
Operator visability:
Of landing: ? fair to good?
Of winch drums: ? good?

Minimum crew size: 1 yarder operator
1 choker setter
1 chaser

Power source: 75-150 hp. (56-112 kW) truck engine or self contained engine

Cost of system (1977): ? $90,000 to $100,000 ? mounted on a new Mercedes-Benz, Unimog, 4-wheel-drive truck

General Data - Urus Class IV



(Courtesy Reinhold Hinteregger)

Operating range: with 25 mm (1'') skyline - 500 meters (1600 ft.)
with 20 mm (25/32'') skyline - 1000 meters (3200 ft.)

Winch drum capacities:
Haul-in: with 14 mm (9/16'') wire rope - 500 meters (1600 ft.)
with 11 mm (7/16'') wire rope - 1000 meters (3200 ft.)
Haul-back: with 14 mm wire rope - ? 1000 meters (3200 ft.)?
with 11 mm wire rope - ? 2000 meters (6400 ft.)?
Skyline: same as operating range
Strawline: with 5.5 mm (7/32'') - ? 2000 meters (6400 ft.)?

Load capacity: with 25 mm skyline & 14 mm haul-in & haul-back lines
Fully suspended: 3500 kg. (7700 lbs.)
Partially suspended: 6000 kg. (13,200 lbs.)
with 20 mm skyline & 11 mm haul-in & haul-back lines
Fully suspended: 2000 kg. (4400 lbs.)
Partially suspended: 3000 kg. (6600 lbs.)

Guylines: 2 main - 18 to 22 mm (23/32 to 7/8'')
2 safety - 16 to 20 mm (5/8 to 25/32'')

Tower:
Height: 9.6 meters (31 ft.)
Construction: single, box steel mast with braces
Erection: threaded spindle or hydraulic

Weight:
Yarder with wire ropes: 11,000 kg. (22,000 lbs.)
Skyline carriage & rigging hardware: 700 kg. (1540 lbs.)
Minimum truck weight: 6000 kg. (13,200 lbs.)

Operator visability:
Of landing: ? fair to good?
Of winch drums: ? good?

Operator protection: Good

Minimum crew size: 1 yarder operator
2 chokermen
1 chaser

Power source: 150-250 hp. (112 - 186 kW) truck engine or self contained engine

Cost of system: available from manufacture - varies with choice of options and mountings

KOLLER 800

The Koller 800 yarder is sized between the ''Urus'' class III and class IV skyline yarders, and is o. similar design. The yarder can be mounted on a truck or trailer of the purchaser's choosing.

General Data - Koller 800

Operating range: with 24 mm (15/16'') skyline - 750 meters (2400 ft.)

Winch drum capacities:
Haul-in: with 12 mm (15/32'') wire rope - 750 meters (2400 ft.)
Haul-back: with 12 mm wire rope - 750 meters - smaller diameter wire rope must be used if a haul-back line between 750 and 1500 meters is needed
Skyline: same as operating range

Line speeds:
Haul-in: 0-375 meters/minute (1230 fpm)
Haul-back: 0-375 meters/minute (1230 fpm)

Line speed & power control: throttle and hydrostatic transmission

Line pull:
Skyline: 9700 kg. (21,300 lbs.)
Haul-in: 1370 kg. - 5300 kg. (3000 - 11,700 lbs.)
Haul-back: same as haul-in

Load capacity: 5000 kg. (11,000 lbs.)

Guylines: 4

Tower:
Height: 10 meters (33 ft.)
Construction: single, box steel mast
Erection: hydraulic

Weight: not available

Controls: ? good ?

Operator visability:
Of landing: fair to good
Of winch drums: excellent

Operator protection: excellent

Minimum crew size: 1 yarder operator
1 or 2 choker setters
1 chaser

Power source: 152 hp. (113 kW) engine

Mounting: optional - purchaser's choice of truck or trailer

Skyline carriage: must be purchased separately
Model recommended: Koller SKA 5 - load locking and self clamping
Weight: 420 kg. (925 lbs.)
Cost: $9,300 (December 1978) nearest European seaport

Cost of yarder: $100,000 (December 1978) nearest European seaport less truck or trailer mounting

Additional equipment needed for operation:
Truck or trailer mounting
Wire ropes (except guylines)
Radio communications system

Manufacturer: J. Koller Seilkranbau
Endach 1
A-6330
Kufstein, Austria

KOLLER 300

Designed for uphill logging, the "Koller 300" is a portable unit which mounts on the 3-point hitch of a farm tractor and is powered by the PTO. A two section winch drum stores and tensions the skyline while a second drum serves as the haul-in. Two small hand-powered winch drums store and tension the two tower guylines.

Since there is no haul-back, the skyline carriage must return to the woods by gravity, thus the "Koller 300" is limited to upslope yarding on gradients exceeding 15%.

General Data - Koller 300

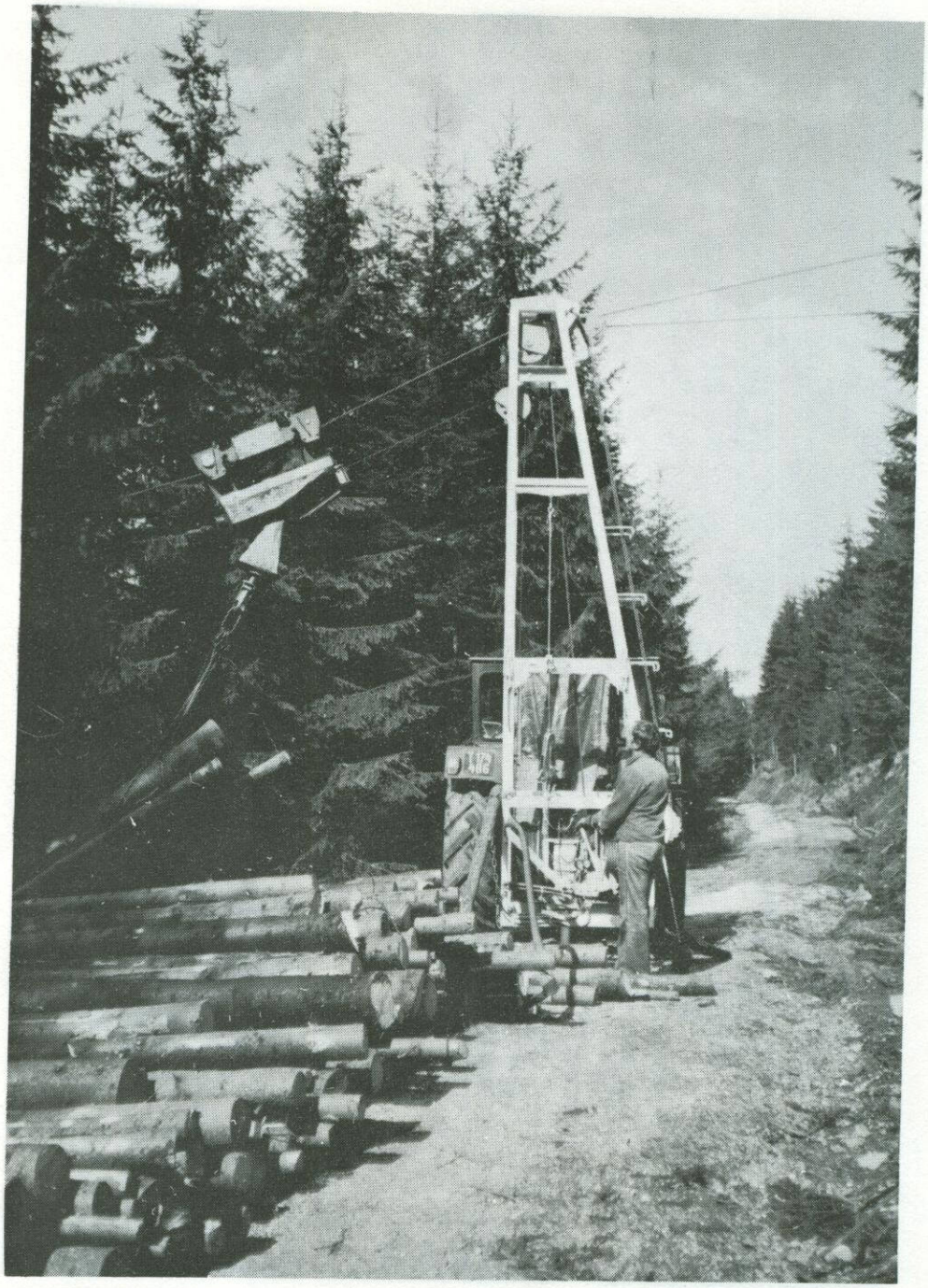
Operating range: with 14 mm (9/16") skyline - 420 meters (1400 ft.)

(Courtesy J. Koller Seilkranbau)

Winch drum capacities:
Haul-in: with 9.5 mm (⅜'') wire rope - 400 meters (1300 ft.)
with 8 mm (5/16'') wire rope - 470 meters (1550 ft.)
Skyline: with 16 mm (⅝'') wire rope - 340 meters (1100 ft.)
with 14 mm (9/16'') wire rope - 420 meters (1400 ft.)

Line speeds: average at 500 PTO rpm's
Haul in: 96 meters/minute (315 fpm)
Freewheeling gravity return

Line speed & power control: hand throttle with control cable to tractor



(Courtesy J. Koller Seilkranbau)

Average line pull:
Haul-in: 1790 kg. (3950 lbs.)
Skyline tensioning: 4500 kg. (9900 lbs.)

Load capacity: 1000 kg. (2200 lbs.)

Guylines: 2-13 mm (½'') X40 meters (130 ft.)

Tower:
Height: 6 meters (20 ft.)
Construction: steel A-frame
Erection: manual winch

Weight: 1200 kg. (2600 lbs.) including wire ropes

Controls: ? good ?
Winch clutches & brakes: hydraulic assist
Throttle: hand

Operator visability:
Of landing: excellent
Of winch drums: good

Operator protection: fair - no cab or safety canopy, but also no downhill yarding

Minimum crew size: 1 yarder operator
1 choker setter

Power source: PTO of 40 hp. (30 kW) or larger farm tractor

Mounting: 3-point hitch of farm tractor

Skyline carriage: must be purchased separately
Model recommended: Koller SKA 1 - load locking and self clamping
Weight: 150 kg. (330 lbs.)
Cost: $5,600 (December 1978) nearest European seaport

Cost of Yarder: $10,400 (December 1978) including wire ropes

Optional equipment: enlarged winch drums for 500 meter (1600 ft.) operating range

Additional equipment needed for operation:
Farm tractor
Radio communications system

Manufacturer: J. Koller Seilkranbau

DOUBLE DRUM WINCHES

At least one make of double drum winch, designed for mounting on the 3-point hitch of a farm tractor, can be converted from use as a ground skidding unit to a standing skyline yarder.

Please see section on double drum winches.

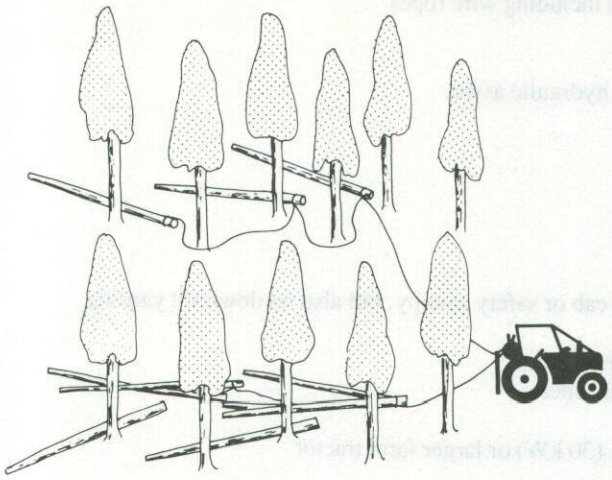
DOUBLE DRUM WINCHES

There are many makes and sizes of double drum logging winches manufactured in Europe. These winches may be purchased as bare units or with varying styles of butt plates for mounting on the rear of agricultural tractors and powering by the PTO. Many European skidders (or specialized logging tractors) are also equipped with double drum winches.

A double drum winch mounted on the rear of a farm tractor or skidder can be employed for ground skidding in much the same manner as a single winch mounted on a typical, North American log skidder. The double drum winch offers advantages for extracting thinnings or scattered logs since the winch lines can be pulled out in two directions.

IGLAND DOUBLE DRUM WINCHES

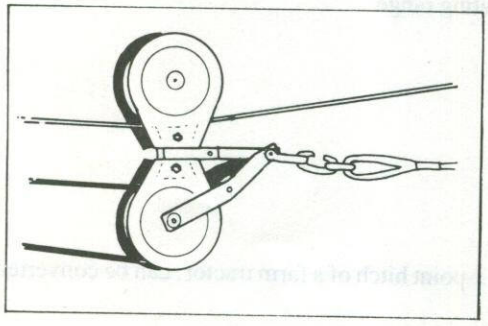
At least one make of double drum winch, the "Igland", is equipped with brakes and clutches that allow it to be used for highlead, running skyline, or standing skyline yarding, with the addition of a tower and a small amount of rigging gear. Distances that can be yarded by these methods are limited by the wire rope capacities of the winch drums, and the amount of lift that can be applied to a turn of logs at a given distance from the yarder (see sections on highlead, running skylines, and standing skylines). In each of the methods varying degrees of tension are maintained between the haul-in and haul-back by applying the brake to one winch while winding in the other.

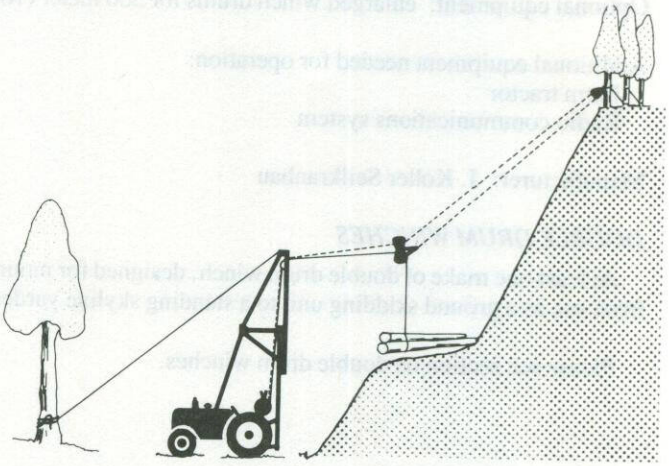


(Courtesy James Jones & Sons, Ltd.)

The highlead system provides the least lift to the turn and thus is seldom used.

The running skyline employs a traveling block which runs on the tensioned haul-back with the haul-in line passing over the lower block. This system rigs up easily in 10-20 minutes and considerbly more lift is provided to a turn of logs than with the highlead method. Still the yarding distance is limited to 100-200 meters (330-660 ft.) by terrain and the amount of allowable deflection.





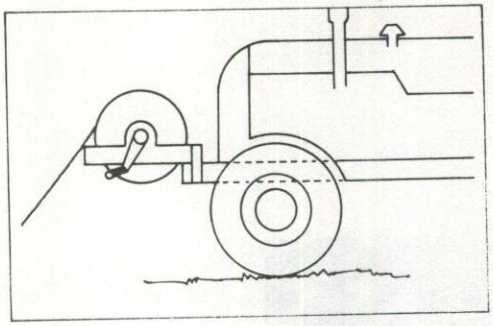
(Courtesy James Jones & Sons, Ltd.)

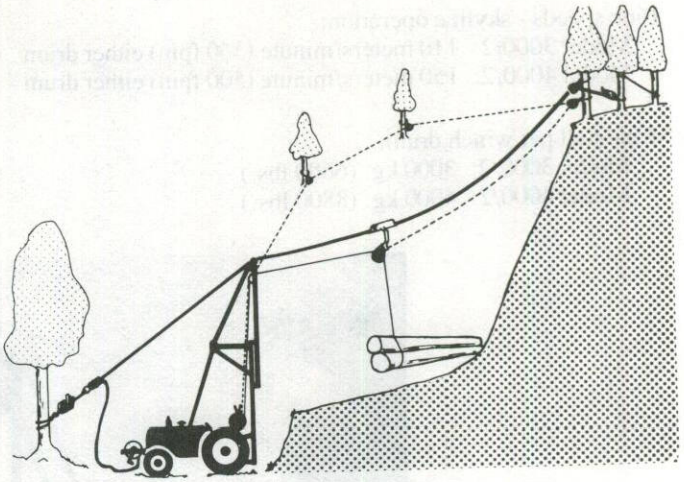
The maximum practical yarding distance for the standing skyline system is less dependent on terrain since skyline supports may be added where necessary to maintain the desired lift on the turns. There is no skyline storage drum or tensioning winch on a double drum winch unit, thus a separate storage drum must be provided. The standing skyline is erected along the logging corridor in the normal fashion with skyline supports placed where needed. The skyline is passed over the top of the tractor mounted tower and attached to a convenient anchor in direct line with the skyline layout. A carriage is mounted on the skyline; one winch is rigged as a haul-back and the other as the haul-in. The skyline is then tensioned with a hand winch.

Less tension between the haul-in and haul-back lines is required for this system than with the running skyline, thus there is a savings in brake and cable wear, and energy required for yarding. Set up times with a two man crew may vary from one to four hours depending on terrain and yarding distances.

General Data - Igland Double Drum Winches

(only ground skidding/cableway winches are listed)





(Courtesy James Jones & Sons, Ltd.)

Operating range:*
Model 3000/2: with 8 mm (5/16'') haul-in - 150 meters (500 ft.)
Model 4000/2: with 8 mm (5/16'') haul-in - 400 meters (1300 ft.)
*a smaller diameter haul-back must be used to achieve maximum operating range

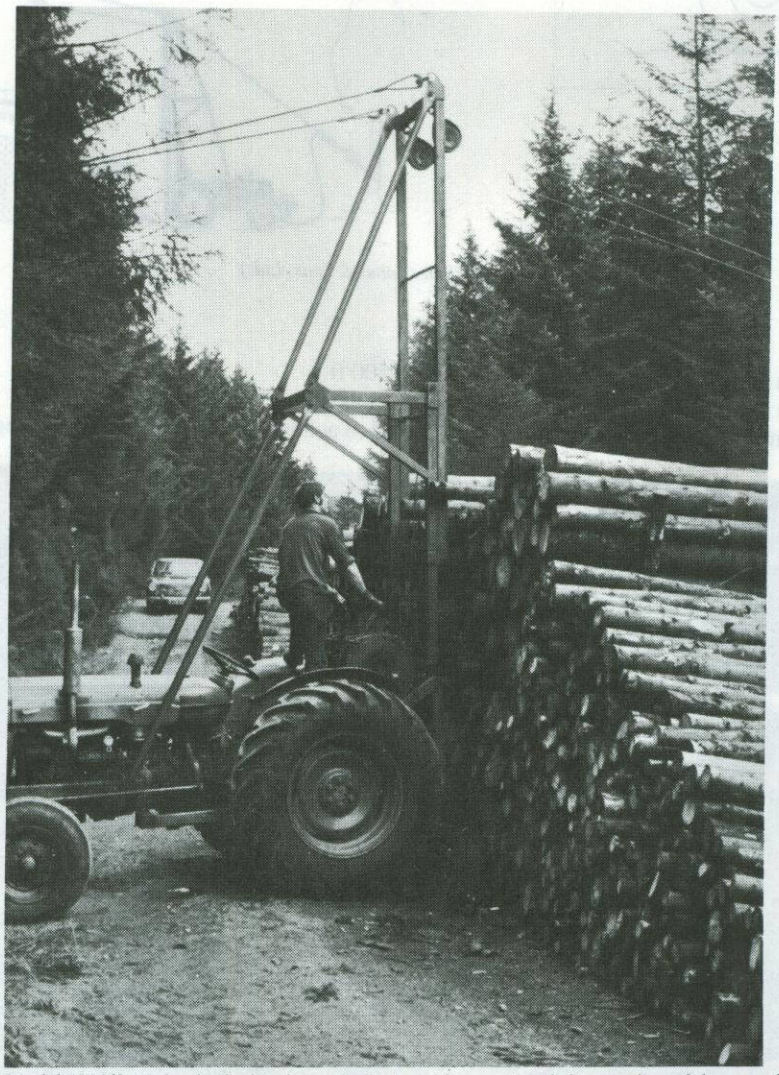
Model 3000/2 ''Igland'' double drum winch rigged for ground skidding.
(Courtesy James Jones & Sons, Ltd.)

Winch drum capacities:
Model 3000/2: either drum with 8 mm (5/16'') wire rope - 150 meters (500 ft.)
Model 4000/2: either drum with 8 mm (5/16'') wire rope - 400 meters (1300 ft.)

Line speed & power control: both models - tractor throttle

Line speeds - skyline operation:
Model 3000/2: 110 meters/minute (360 fpm) either drum
Model 4000/2: 150 meters/minute (500 fpm) either drum

Line pull per winch drum:
Model 3000/2: 3000 kg. (6600 lbs.)
Model 4000/2: 4000 kg. (8800 lbs.)



Model 4000/2 "Igland" double drum winch rigged for running skyline yarding of shortwood. (Courtesy James Jones & Sons, Ltd.)

Controls: good - both models
Winch clutches & brakes: manual - both models

Operator visability:
Of landing: Excellent - both models
Of winch drums: Excellent - both models

Operator protection: fair - both models

Minimum crew size for either model:
1 yarder operator
1 choker setter

Power source:
Model 3000/2: 40 to 50 hp. (30 to 37 kW) farm tractor
Model 4000/2: up to a 70 hp. (52 kW) farm tractor

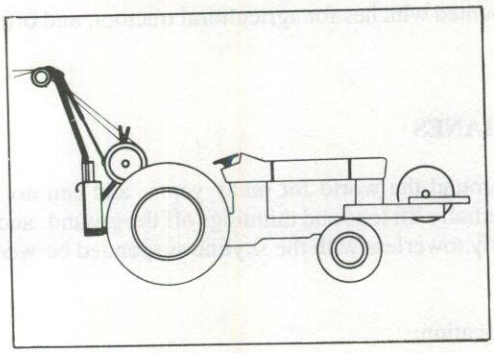
Weight - rigged for ground skidding:
Model 3000/2: 152 kg. (330 lbs.)
Model 4000/2: 357 kg. (780 lbs.)

Mounting: rear of a farm tractor - with either a fixed or 3-point hitch mounting

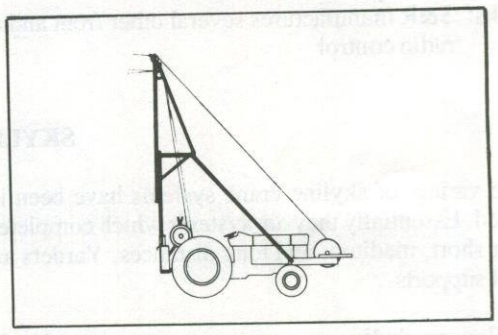
Cost of winch units equipped for ground skidding - purchased in U.S.:
Model 3000/2: 3-point hitch mount - $4,700*
fixed mount - $4,000*
Model 4000/2: 3-point hitch mount - $7,350*
fixed mount - $6,650*
*prices as of January 1979

Additional equipment needed for ground skidding:
Farm tractor

Additional equipment needed for cableway operation:
Farm tractor
Tower: short - $1,070*
medium - $1,470*
tall, folding - price not available - 5.5 meters (18 ft.)
Rigging & carriage
Radio communications system



Short Tower



Tall, Folding Tower

(Courtesy James Jones & Sons, Ltd.)

Largest known distributor: James Jones & Sons, Ltd.
P.O. Box 35
Broomage Avenue
Larbert, Stirlingshire
Scotland, United Kingdom
FK5 4NQ

U.S. Importer: Indag Iowa, Inc.
P.O. Box 1227
Spencer, Iowa 51301

Manufacturer: Per Iglands Fabrikk A/S
4890
Grumstad, Norway

OTHER DOUBLE DRUM WINCHES

The following is a partial listing of other makes of double drum logging winches. None of the manufacturers of these winches advertise them for use in cableway yarding.

Farmi - model JL 2/45: for 120 hp. (90 kW) tractors and up
U.S. Distributor: Northeastern Implement Corp.
Walpole, New Hampshire 03608
Manufacturer: Orion-Yhtyma Oy
Normet, Finland
Remarks: three models of single drum winches are available for tractors from 18 hp. (13.5 kW) up

Sepson - model 18-20: Type H 1 for 50 hp. (37 kW) tractors
Type H 2 for 100 hp. (75 kW) tractors

Manufacturer: Sepson AB
S-780 50
Vansbro, Sweden
Remarks: Sepson also manufactures a wide range of single drum winches for a variety of applications

S & R - Types 230 & 240: rear mounted
Type 261: front mounted
Manufacturer: Sehlang & Reichart
Mashinenfabrik
D-8952
Marktoberdorf, Germany
U.S. importer: Indag Iowa, Inc.
P.O. Box 1227
Spencer, Iowa 51301
Remarks: S&R manufactures several other front and rear mounted winches for agricultural tractors, and offers remote radio control

SKYLINE CRANES

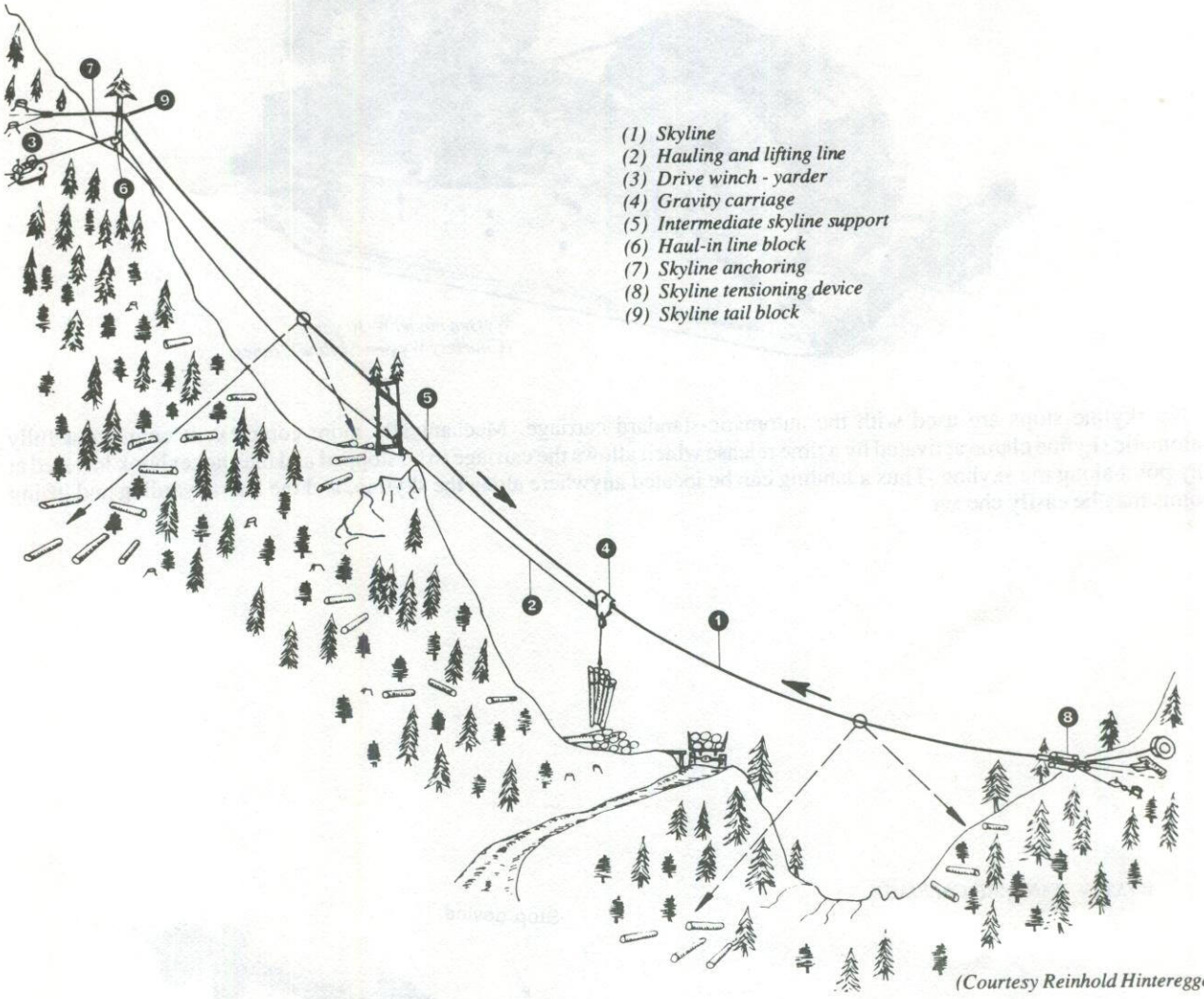
A wide variety of skyline crane systems have been in use around the world for many years, and can not be neatly categorized. Essentially they are systems which completely or partially lift logs and thinnings off the ground, and transport them over short, medium, and long distances. Yarders are usually towerless with the skyline suspended between trees or fabricated supports.

The following skyline crane systems are reviewed in this publication:
-Wyssen (5 models and options manufactured)
-Baco (several models and options offered)
-Vinje K-1200 (radio controlled)
-Nansei (radio controlled)
-Japanese "Tyler"
-Hinteregger skyline carriages

There are many other skyline crane systems, but they have not been reviewed because they are either similar to those discussed or not well suited for yarding small timber. A few of the others are:
-Seidel (similar to Wyssen and Baco with endless cable drive)
-Iwate-Fuji (similar to Wyssen and Baco)
-Arlberg (similar to Wyssen and Baco)
-Mariabrunn (uses a carriage with a load lifting block)
-Blondin (similar to "North Bend" and "Tyler")
-Pesherecio (modified Blondin)
-Lortscher (semi-permanent, heavy system which transports logs in horizontal position)
-Kostnapfel (similar to Wyssen and Baco)

WYSSEN SKYLINE CRANES

Skyline crane systems manufactured by Wyssen of Switzerland have been used for logging mountainous terrain throughout the world since the 1940's.

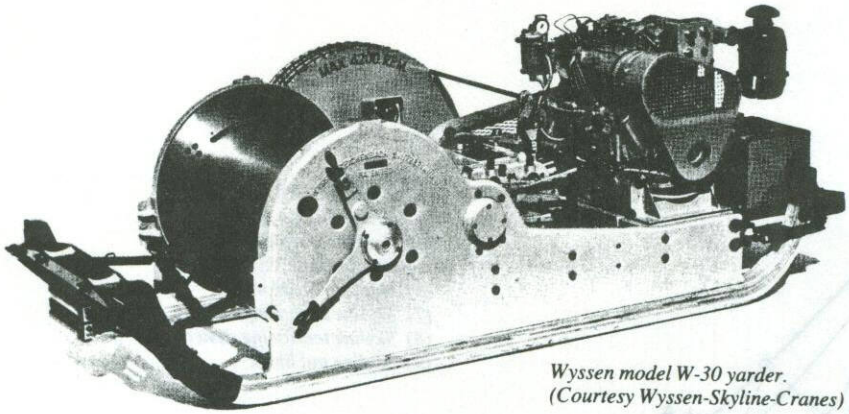


(Courtesy Reinhold Hinteregger)

The main components of the Wyssen system are a single drum yarder and a skyline carriage which rides on a tight skyline. A slope of 25% or more is required for operation since the carriage is moved downslope by gravity and upslope by a haul-in line connected to a single drum yarder positioned at the upper end of the skyline. The sophisticated, and somewhat mechanically complicated carriage is capable of passing over intermediate skyline supports. Multi-span skylines sometimes reach lengths of up to 9,000 ft. (2750 meters) with the largest yarders. Loads are transported either uphill or downhill to a landing. For downhill yarding, which is the most common, the skyline must be high enough at all points to allow passage of loads completely suspended above the ground.

The self-powered yarders, ranging in size from 15 to 200 hp. (11 to 150 kW), are mounted on skids and winch themselves up slope to an operating position at the top of the logging corridor. Winching the yarder into position can be a difficult and time consuming task if the terrain is exceptionally steep or rough. Once the yarder is positioned, leveled, and anchored, the skyline is attached to the end of the haul-in line and winched up the logging corridor. Intermediate skyline supports are erected where necessary, the carriage and any stops are placed on the skyline, and the skyline is tensioned and secured to suitable anchors.

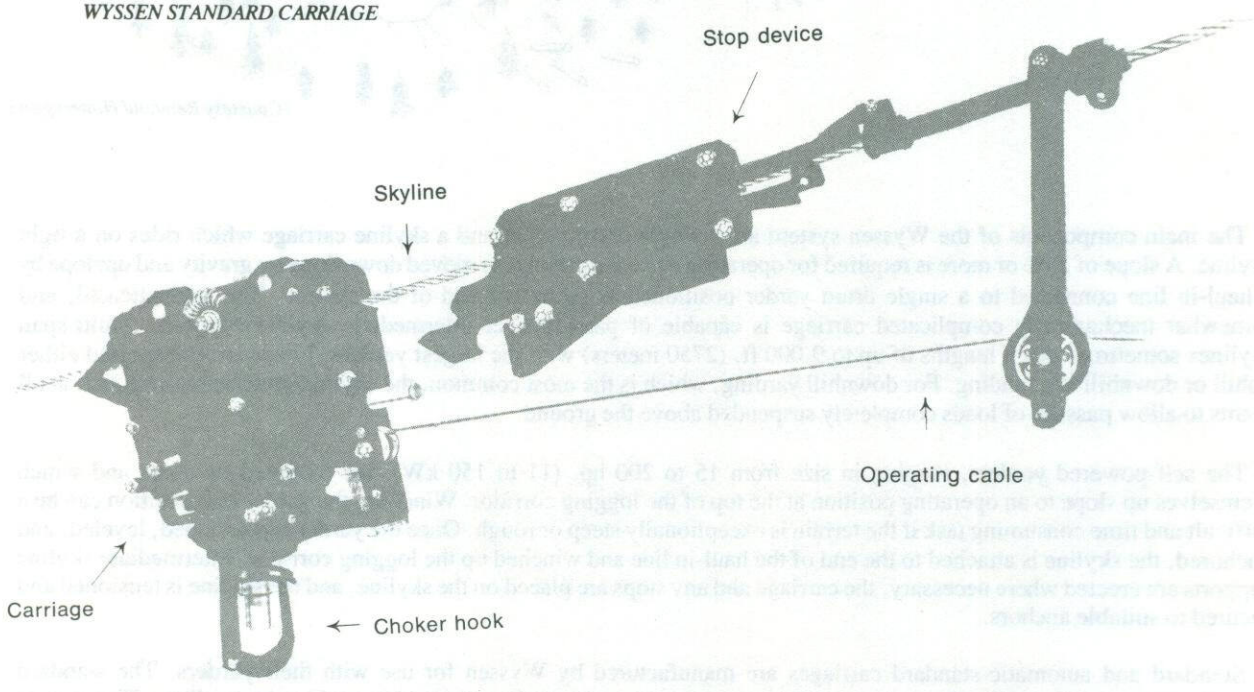
Standard and automatic-standard carriages are manufactured by Wyssen for use with their yarders. The standard carriage requires two moveable stop/release devices mounted on the skyline and held in position by guylines. These stops are at the lifting point in the forest and at the landing. When the carriage engages and locks onto the skyline stop, the choker hook is released and is lowered to the ground where a turn of logs or bundle of thinnings is attached by the chokerman. The hook is then raised until it locks into the carriage, simultaneously releasing it from the stop. The carriage then begins its travel to the landing.



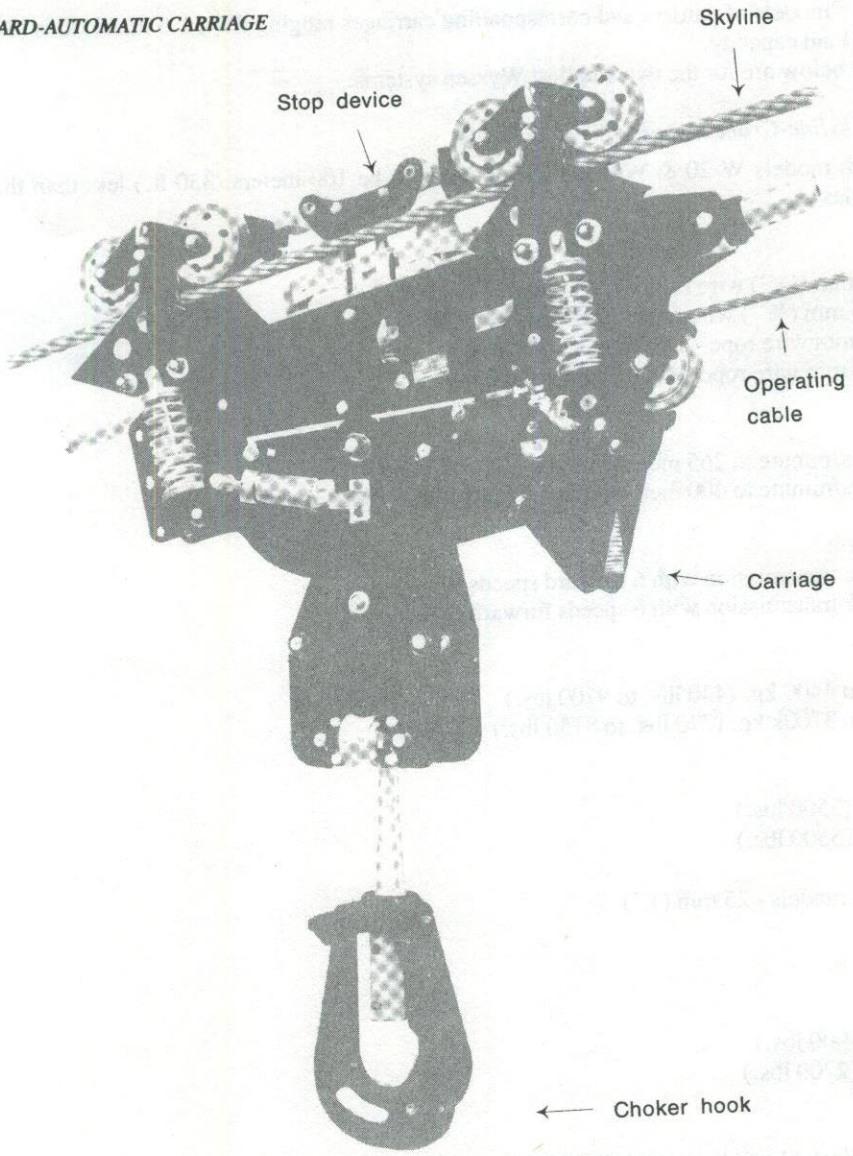
Wyssen model W-30 yarder.
(Courtesy Wyssen-Skyline-Cranes)

No skyline stops are used with the automatic-standard carriage. Mechanically more complex, it employs a fully automatic skyline clamp activated by a time release which allows the carriage to be stopped and the choker hook lowered at any point along the skyline. Thus a landing can be located anywhere along the skyline, and the lateral yarding and lifting points may be easily chosen.

WYSSEN STANDARD CARRIAGE



WYSSEN STANDARD-AUTOMATIC CARRIAGE



(Courtesy Wyssen-Skyline-Cranes)

On both carriages the haul-in line passes through the carriage and is attached to the choker hook, serving as the lateral yarding and lift line. Thus lateral yarding distances are not limited by the length of the lift line. In practice, the average yarding distance is roughly 50 meters (165 ft.) to either side of the skyline.

''Unimat'' drive: For logging upslope, downslope, or level settings, the W-30 and larger Wyssen yarders may be fitted with an endless cable drive. A special friction drive and fairleads are fitted on the yarder drum which powers an endless cable. The endless cable moves a specially adapted standard-automatic carriage along the skyline in either direction. When the carriage is stopped it clamps itself to the skyline, and the endless cable winds a driving spool which lowers the lift line and choker hook. To raise the load, the direction of endless cable movement is reversed until the choker hook engages the carriage and releases the skyline clamp. The carriage is then pulled toward the landing by the endless cable.

The ''Unimat'' drive offers the convenience of positioning the yarder at either end of the skyline and of logging any terrain, but the endless cable may require cutting and splicing as yarding distances change from setting to setting. Positioning the yarder near the roadside landing area saves time consuming winching of the yarder to the upper end of the logging corridor and also affords the yarder operator a view of the landing. Skyline supports need not be as high since a constant pull is applied to the carriage and loads touching the ground do not decrease the yarding speed.

Wyssen sysems were tested in New York and eastern Canada in the 1940's with fairly good results, but they are much slower to rig and less versatile than the more recently developed truck, or trailer mounted standing skyline yarders.

Wyssen manufactures 5 models of yarders and corresponding carriages ranging from 1.5 metric tons (3300 lbs.) to 15 metric tons (33,000 lbs.) load capacity.

The general data given below are for the two smallest Wyssen systems:

General Data - Wyssen-Skyline-Cranes, models W-20 & W-30:

Operating range: for both models W-20 & W-30 this is assumed to be 100 meters (330 ft.) less than the winch drum capacities

Winch drum capacities:
Model W-20: with 13 mm (½'') wire rope - 1200 meters (3900 ft.)
with 9.5 mm (⅜'') wire rope - 1800 meters (5900 ft.)
Model W-30: with 13 mm wire rope - 1300 meters (4300 ft.)
with 9.5 mm wire rope - 1950 meters (6400 ft.)

Line speeds:
Model W-20: 13 meters/minute to 265 meters/minute (42 to 870 fpm)
Model W-30: 30 meters/minute to 400 meters/minute (100 to 1320 fpm)

Line speed & power control:
Model W-20: throttle & transmission with 6 forward speeds
Model W-30: throttle & transmission with 6 speeds forward & reverse

Line pull:
Model W-20: 200 kg. to 4400 kg. (440 lbs. to 9700 lbs.)
Model W-30: 350 kg. to 3700k kg. (770 lbs. to 8150 lbs.)

Load capacities:
Model W-20: 2500 kg. (5500 lbs.)
Model W-30: 2500 kg. (5500 lbs.)

Skyline diameter: for both models - 25 mm (1'')

Tower: None

Weight: less wire rope
Model W-20: 860 kg. (1900 lbs.)
Model W-30: 1230 kg. (2700 lbs.)

Controls: good
Brakes: dual system - adjustable air brake and shoe brake

Operator visability:
Of landing: usually none
Of winch drum: good

Operator protection: none - there is little danger to the operator from timber being yarded or snapping cables

Minimum crew size: 1 yarder operator
1 chokerman
1 chaser

Power source:
Model W-20: 15 hp. (11 kW) self-contained engine
Model W-30: 35 hp. (26 kW) self-contained engine

Mounting: sled

Standard skyline carriage: load locking, multi-span
Standard-automatic carriage: load locking, multi-span, self-clamping
Unimat carriage: load locking, multi-span, self-clamping, with 3:1 reduction ratio from endless line speed to lift line speed

Special features: model W-30 may be equipped with "Unimat" drive for all terrain yarding

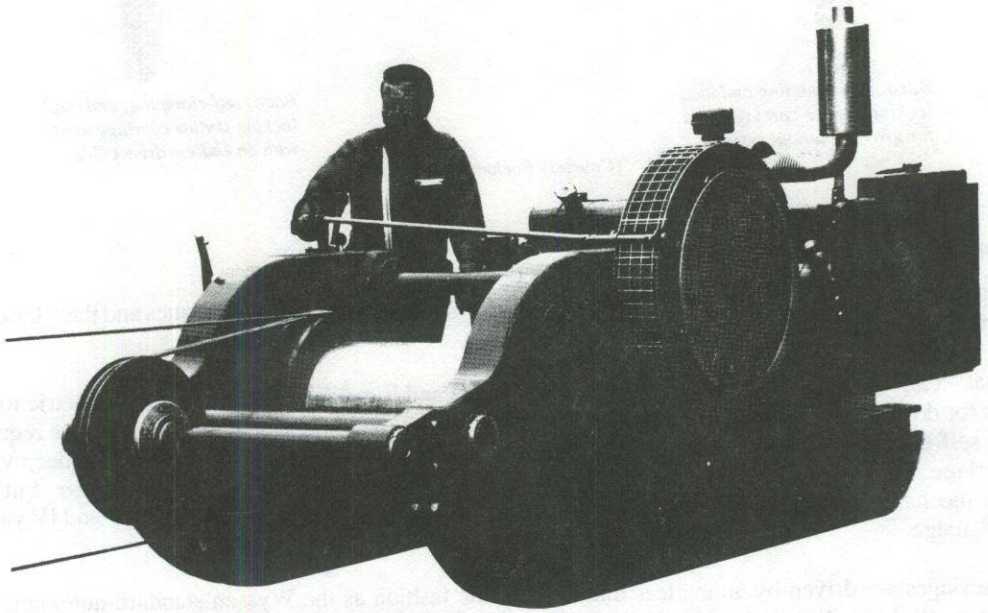
Cost of systems: with wire ropes, radios, and all accessories needed for operation - Switzerland
Model W-20: $65,000 (1978)
Model W-30: $71,000 (1978) - "Unimat" drive: $11,000 (1978)

Manufacturer: Wyssen-Skyline-Cranes Co., Ltd.
Ch - 3713 Reichenbach
Kandertal, Switzerland

BACO SKYLINE CRANES

Several models of yarders and corresponding carriages are manufactured by Baco. The yarders are very similar to the Wyssen yarders while the skyline carriages closely resemble those manufactured by Reinhold Hinteregger. The yarders may be fitted with an endless cable drive, and the larger units are equipped with automatic transmissions.

Load capacities of the Baco systems range from 2 metric tons (4400 lbs.) to 15 metric tons (33000 lbs.).

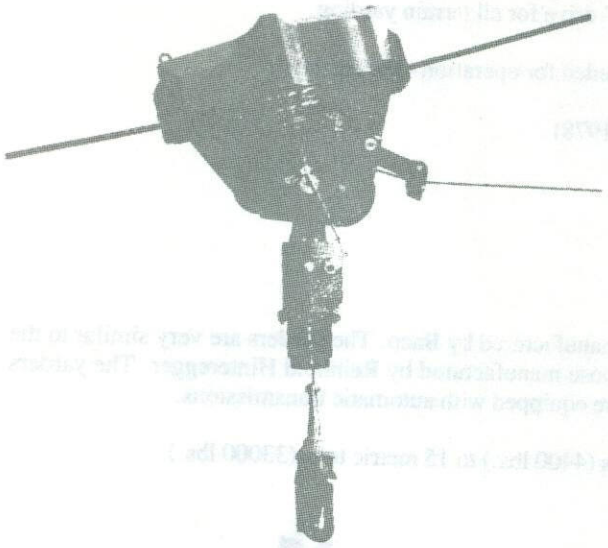


Baco yarder equipped with endless cable drive for all terrain yarding.
(Courtesy BAchmann & Co. AG)

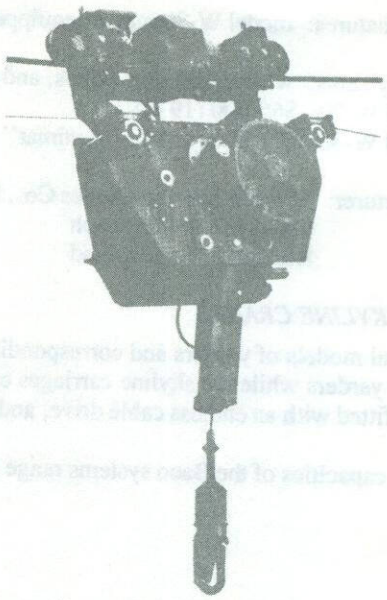
U.S. Sales & Maintenance: Baco Skyline Logging Equipment
2416 Holly Lane
Olympia, Washington 98501

Manufacturer: Bachmann & Co. AG
Baco - Seilbahnen
CH - 3613
Steffisburg-Thun, Switzerland

A system similar to the Wyssen and Baco systems is manufactured by:
Establissemants Muffat
74420
Boege, France



Baco, self-clamping and load-locking skyline carriage used for gravity outhaul systems.



Baco, self-clamping, and load-locking skyline carriage used with an endless drive cable.

(Courtesy Bachmann & Co. AG)

HINTEREGGER SKYLINE CARRIAGES

Reinhold Hinteregger of Austria offers a variety of skyline carriages for use with skyline cranes and the "Urus" yarders they manufacture.

The "Gravimat" carriage is similar to the Baco gravity carriage and is available in two and three metric ton models. They use gravity for downslope movement and require a minimum slope of 15 - 25%. No skyline stops are required since the carriages are self-clamping at any point on the skyline. Loads can be laterally yarded or lifted from deep valleys and locked to the carriage. The "Gravimat" is similar in function to the Wyssen standard-automatic carriage, but has fewer exposed, delicate mechanical parts, thus it can be used for uphill yarding with the "Urus" class II, III, and IV yarders with minimal risk of damage.

"Hibamat" carriages are driven by an endless line in the same fashion as the Wyssen standard-automatic carriages equipped for "Unimat" drive. A horizontal load bar may be added to these carriages which increases load capacity by 50% and allows loads to be transported in a horizontal position (Wyssen and Baco carriages also offer the same option). "Habimat" carriages may be purchased in 2, 3, 5, and 8 metric ton models.

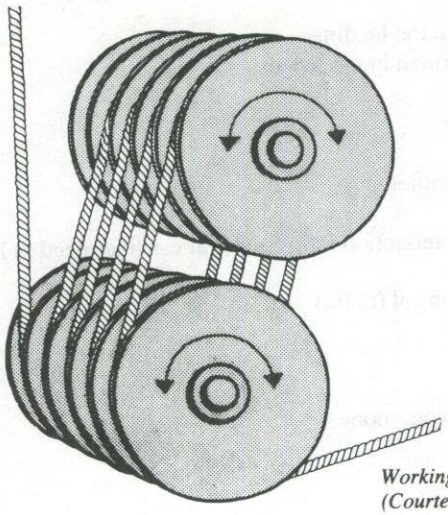
Manufacturer: Reinhold Hinteregger
Maschinen-und Seibahnbau
Zehenthofstr. 33, Postfach 42
A-9500 Villach, Austria

VINJE K-1200

Developed by the Norwegian Forest Research Institute in cooperation with Ragnvald Nestestog, the "Vinje K-1200" is remotely controlled by the chopper/chokerman and the chaser/bucker. No yarder operator, per se, is required.

The "Vinje" yarder can be a truck mounted unit powered by its own engine or a unit mounted on the rear of a tractor and powered by the tractor's engine. Support equipment for the tractor mounted yarder is transported on a separate trailer. A hydraulically driven, multi-groove traction winch powers an endless cable which runs to a capstan in the skyline carriage, through the carriage, around the cutting area, and back to the yarder. The multi-span skyline, up to 900 meters (3000 ft.) long, is rigged with a skyline carriage stop at the landing, and a moveable stop at the lift point in the forest. When the carriage is between stops, the capstan is locked and the carriage is moved in one direction or the other by the endless line. When the carriage contacts a stop, they lock together and the capstan is released. Continued driving of the endless line lowers the lifting line. To raise the lifting line the direction of the endless line is reversed, thus winding the capstan in the

opposite direction. When the choker hook contacts the carriage, the capstan is locked and the carriage is simultaneously released from the stop.



Working principle of a multi-groove traction winch. (Courtesy Kolpe-Patent AB)

All the functions of the skyline system are controlled by a timer and the radio transmitters. The timer, which can be set for varying yarding distances, stops the carriage just before it reaches either the landing or lifting point. Both the chaser/bucker at the landing and the feller/chokerman in the woods have a radio control set. When the landing is cleared or a turn is ready for choking, the respective worker radios the carriage in the final distance to the stop, and the lifting line is lowered. Thus this system is designed to co-ordinate the felling and bucking processes with a minimum amount of operator time required for yarding.

The ''Vinje K-1200'' has been used successfully in Norway on integrated sawlog/pulpwood harvests. Trials for pulpwood harvesting in Newfoundland were conducted in 1973, but the ''Vinje'' proved unsatisfactory for several reasons:

-too heavy a system for the small timber
-excessive set up (rigging) time
-too mechanically and electronically complicated for the inexperienced crews
-no repair information or spare parts were available

General Data - ''Vinje K-1200'':

Operating range: 900 meters (3000 ft.)

Winch drum capacities: friction drive for endless cable - cable must be cut & spliced - cable is not wound onto a winch drum

Wire rope sizes:
Skyline: 18 mm (¾'')
Endless drive line: 10 mm (⅜'')
Lifting line: 10 mm

Line speed:
Endless drive line: 228 meters/minute (750 fpm)

Line speed & power control: hydrostatic transmission

Load capacity:
Fully suspended: 2000 kg. (4400 lbs.)

Tower: None

Controls: remote, electronic with six command signals - relay unit & timer - two control units plus spare recommended

Operator visability: excellent

Operator protection: none - remote control allows either operator to stand clear

Minimum crew size: 1 chaser/bucker at the landing
1 chopper/chokerman in the woods

Power source: 100 hp. (75 kW) engine

Mounting: truck or rear of tractor and trailer

Skyline carriage: complex design - 3:1 reduction ratio from endless line speed to lifting line speed - load locking

Special features: Remote, electronic control (radio)

Cost of system: ? $41,000 ? (1973)

Additional equipment needed for operation: none

Manufacturer: Ragnvald Nestestog
Ytre Vinje
Telemark, Norway

JOBU COMBI CAT C-1000/52E

Although the "Combi Cat" is no longer manufactured, it deserves mention for its unique carriage drive system.

The carriage rides on the skyline in the normal fashion, but is driven and operated by two endless lines each connected to a separate capstan on the carriage. By stopping the mainline and driving the operating line in one direction or the other, the lifting line is either raised or lowered. When the two lines are driven in the same direction at the same speed, the lifting line is locked and the carriage travels along the skyline.

This method of driving and operating the carriage eliminates the need for carriage stops on the skyline, thus allowing greater flexibility in choosing loading and unloading points. A major drawback is the extra rigging time required for two endless lines.

The system is remotely operated by radio in much the same fashion as the "Vinje K-1200".

NANSEI SKYLINE CRANE

The Nansei Company of Japan has recently developed a remote, radio controlled skyline crane which uses two endless lines for driving the carriage and winding the lift line drum. Rigging and operation of the system is virtually identical to that of the "Jobu Combi Cat".

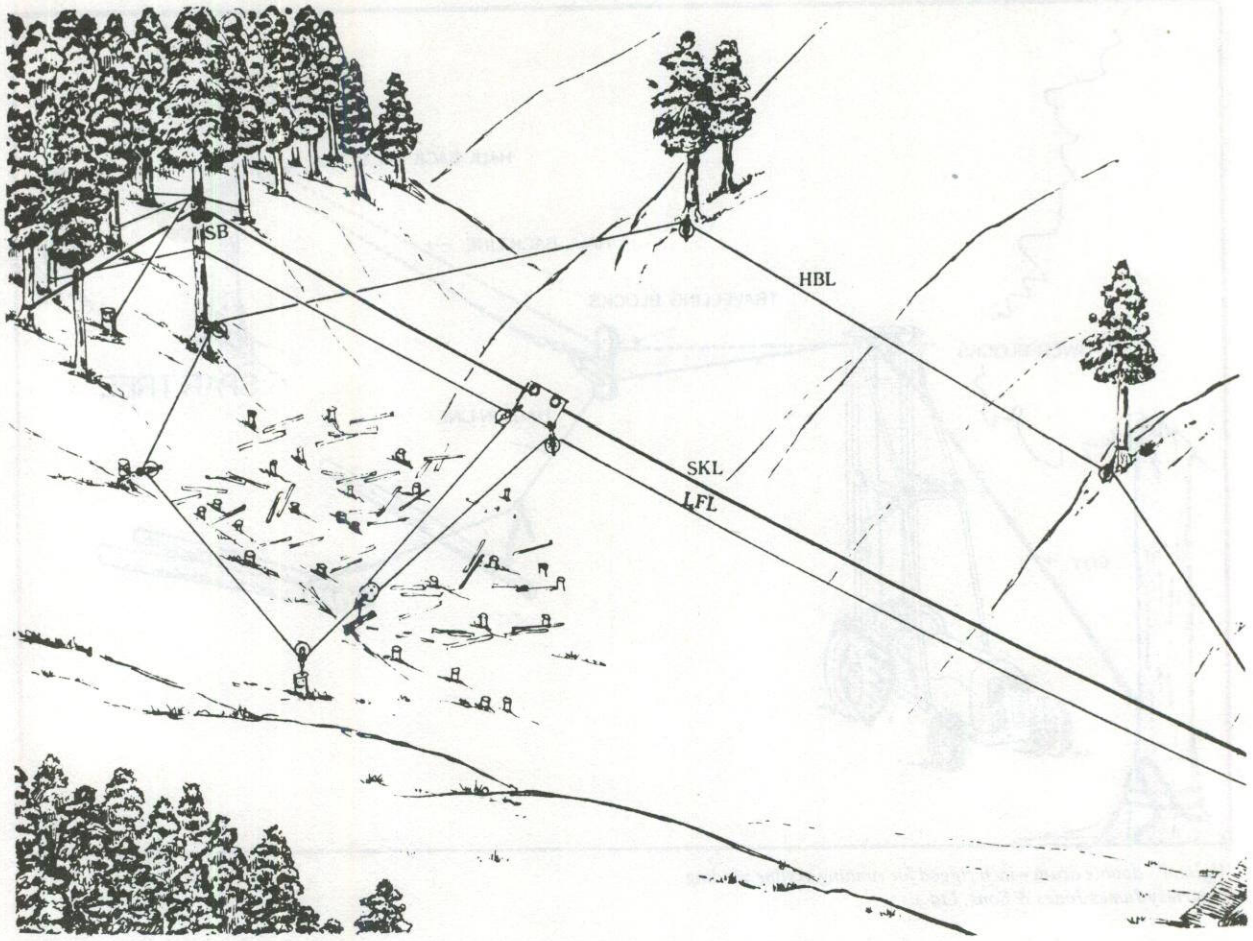
A skid mounted, double drum drive unit powered by a 25 hp. (18.5 kW) diesel engine is positioned near the landing and is remotely controlled by the chokerman and the chaser. Maximum line pull is about 300 kg. (660 lbs.) and average line speed is around 150 meters/minute (500 fpm). A reduction gear in the carriage multiplies the power to the lifting line and reduces its speed to about 25 meters/minute (80 fpm).

This system is suited for the downhill yarding of logs weighing 1000 kg. (2200 lbs.) or less over distances not exceeding 500 meters (1650 ft.). It may be used for logging selectively as well as in clear-cuts, but in either case it would be a time consuming system to rig up.

JAPANESE "TYLER" SYSTEM

Many of the skyline cranes used for logging in Japan's mountainous forests are based on the "Tyler" system. These systems span average distances of 400 meters (1300 ft.) to 500 meters (1650 ft.). Set up times for a 500 meter span on steep terrain may vary between 30 and 40 man days.

The "Tyler" system, which is best suited to logging clear-cuts, uses gravity in-haul on steep downhill slopes with the speed of descent partially controlled by the reverse bend of the lifting line running through the lifting block. The haul-back line is not connected directly to the carriage, but to the lifting block and is used to pull the block down and over to the point where loads are being hooked. A double drum winch unit is required for the downhill "Tyler" system with the skyline



"Tyler" system. (Courtesy United Nations)

stored on a separate reel. Logging uphill or on shallow downhill slopes requires a three drum winch unit rigged with a haul-in line. Yarders may range in power from 20 hp. (15 kW) to over 100 hp. (75 kW), but are most commonly in the 65 hp. (49 kW) to 110 hp. (82 kW) range.

RUNNING SKYLINES

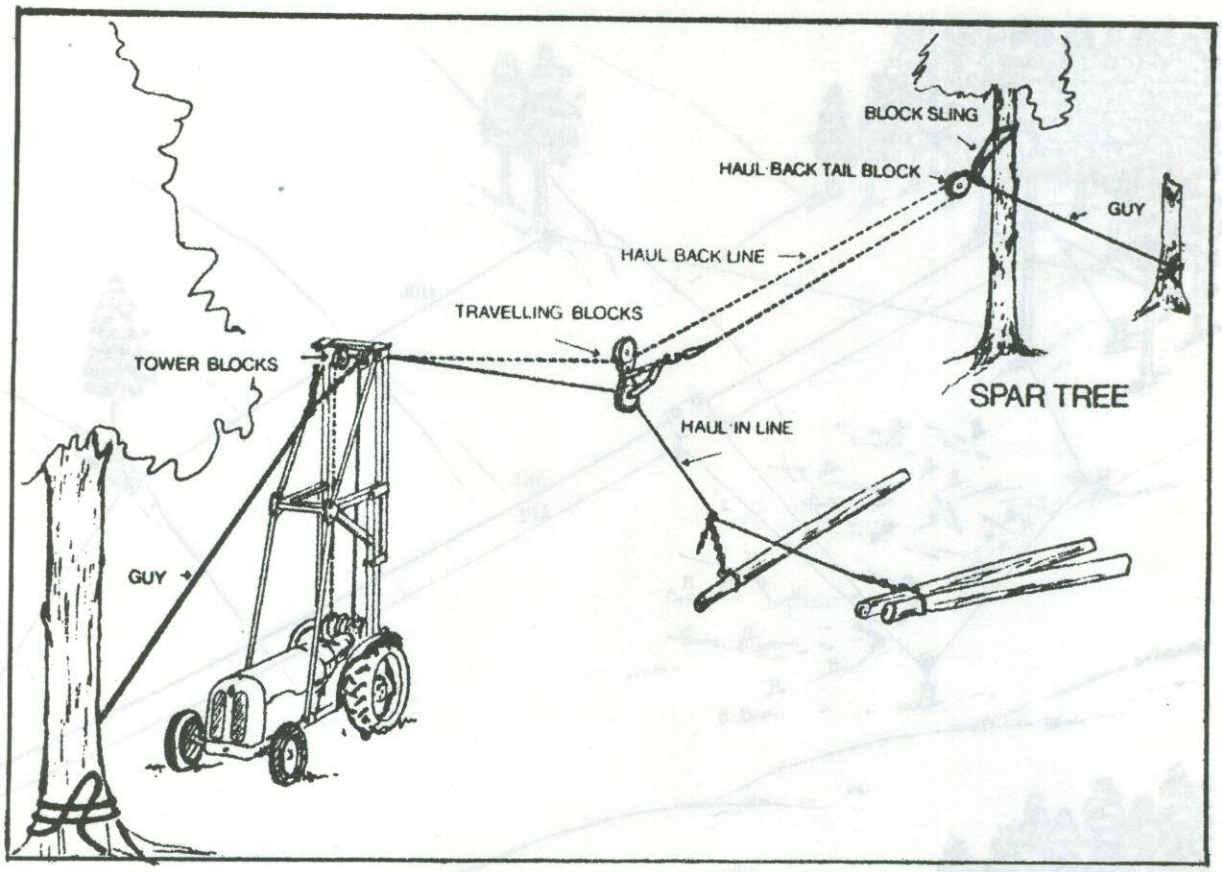
Renewed interest in the potential of running skylines has been sparked by the development of interlocking yarders for logging on the West Coast of North America.

The rotation speeds of the interlocking yarders' haul-in and haul-back drums are synchronized by a mechanism which maintains a uniform tension between the haul-in and haul-back lines. Smaller yarders, such as the "Highland Trailer Alp", and "Igland" double drum winches, must create tension between the haul-in and haul-back lines by applying the brakes to one line while winching in on the other. The interlocking systems save significantly on brake and cable wear, do not rob the yarders of speed and power and offer smoother operation over longer yarding distances.

A running skyline is one of the quickest and simplest cable systems to set up, since only a haul-back and a haul-in line running parallel to each other along the skyline corridor are required for operation, with the carriage simply riding on top of the moving haul-back. No carriage stops, trip devices or intermediate skyline supports are used.

The larger running skyline systems are often equipped with slack pulling carriages, thus requiring a third, slack pulling line for operation (see page 4 & section on large mobile yarders).

Since intermediate supports can not be used with running skylines, yarding distances are limited by the necessity of maintaining adequate line deflection. Maximum yarding distances seldom exceed 100 meters (330 ft.) for small running



"Igland" double drum winch rigged for running skyline yarding.
(Courtesy James Jones & Sons, Ltd.)

systems such as those used with the "Igland" double drum winches, but can range up to 300 meters (1000 ft.) or more for the larger interlocking yarders.

Running skylines can operate on uphill or downhill settings, and have the capability to yard laterally. Thus they may be used for extracting thinnings as well as for logging clear-cuts.

PEEWEE YARDER

The "Peewee" yarder has been recently developed by research engineers at the U.S.F.S. Pacific Northwest Forest and Range Experiment Station. It is the product of their efforts to design a mobile, high performance yarder that can yard small logs uphill or downhill, economically with little environmental damage at distances up to 1200 feet (365 meters).

Mounted on the rear of a skidder, the "Peewee" is an interlocking yarder with a 37 foot (11.3 meters) tower, and three hydraulically driven winch drums. The two lever controls for yarding operations are conveniently placed, allowing the operator to double as chaser.

The first public demonstrations of this yarder were conducted in mid-June 1977, and at that time commercial manufacture of the machines had not been initiated.

General Data - "Peewee" yarder

Operating range: with ½" (12.5 mm) wire ropes - 1200 feet (365 meters)

Line sizes: ½" (12.5 mm) for the three main drums

Line speeds: 750 fpm (230 meters/minute)

Line speed & power control: throttle & hydraulic drive

Tower:
Height: 37 feet (11.3 meters)
Construction: steel lattice
Erection: hydraulic

Weight: with wire ropes - 44,000 lbs. (20,000 kg.)

Controls: excellent - at rear of machine
Winch clutches & brakes: none - all hydraulic drive

Operator visability:
Of landing: excellent
Of winch drums: fair

Operator protection: good

Minimum crew size: 1 operator/chaser
2 choker setters

Power source: skidder engine

Mounting: new or used articulated skidder

Standard Carriage: slack pulling

Special features: all hydraulic drive with no brakes or clutches

Cost of system: (1978) depends on the number of yarders manufactured - est. $50,000 to $60,000 without skidder

Additional equipment needed for operation:
-new or used skidder
-radio communications system

Manufacturer: none as of late 1978

Research engineer: Hilton H. Lysons
U.S.D.A. Forest Service
Pacific Northwest Forest & Range Experiment Station
Seattle, Washington 98105

PURDUE TRACTION CABLE YARDER

An experimental running skyline system underwent testing in 1975, at Purdue University. A single endless cable, instead of separate haul-in and haul-back lines, was wrapped around two traction sheaves on the double drum winch to provide line interlock. Tensioning of the endless line was by a moveable tensioning block controlled by a separate winch.

The complex and time consuming rigging of the system precludes commercial use, but the unique, low cost method of interlocking the yarder drums, and tensioning the running line deserves notice.

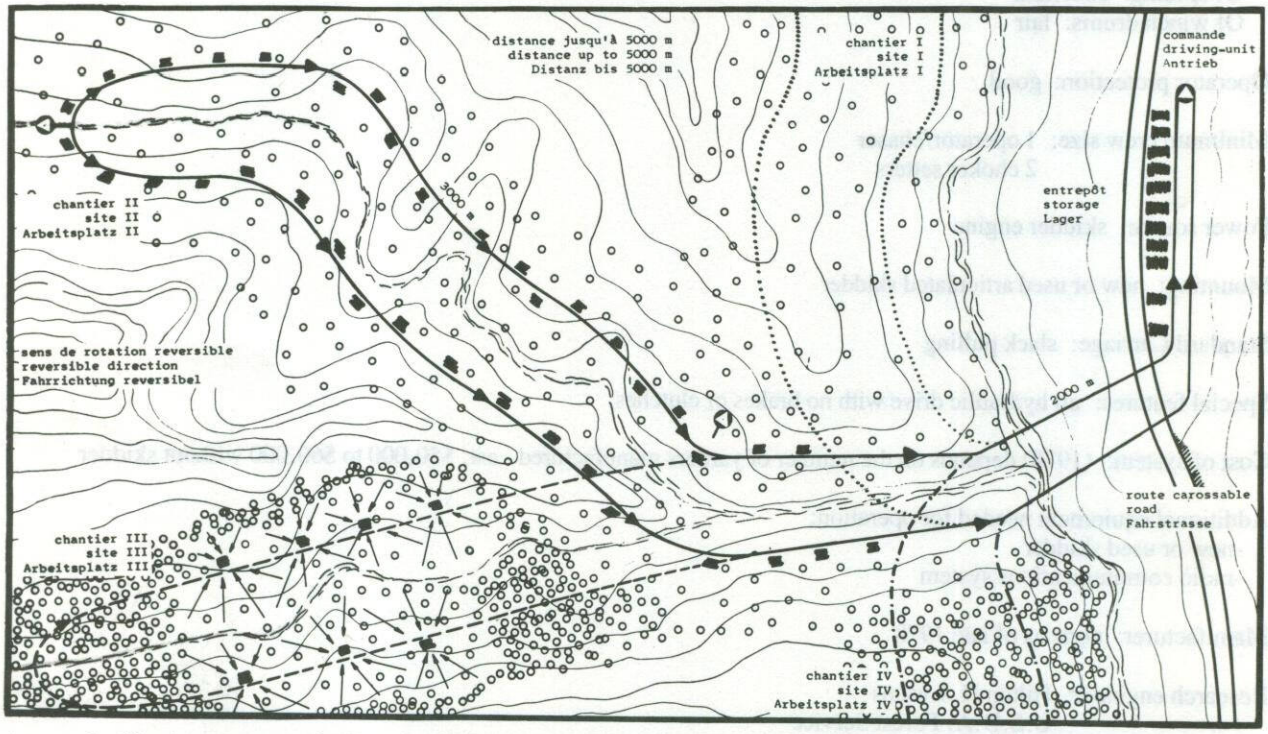
Experimental work by: Department of Forestry and Natural Resources
Purdue University
West Lafayette, Indiania 47907

CIRCULATING MONOCABLE SYSTEMS

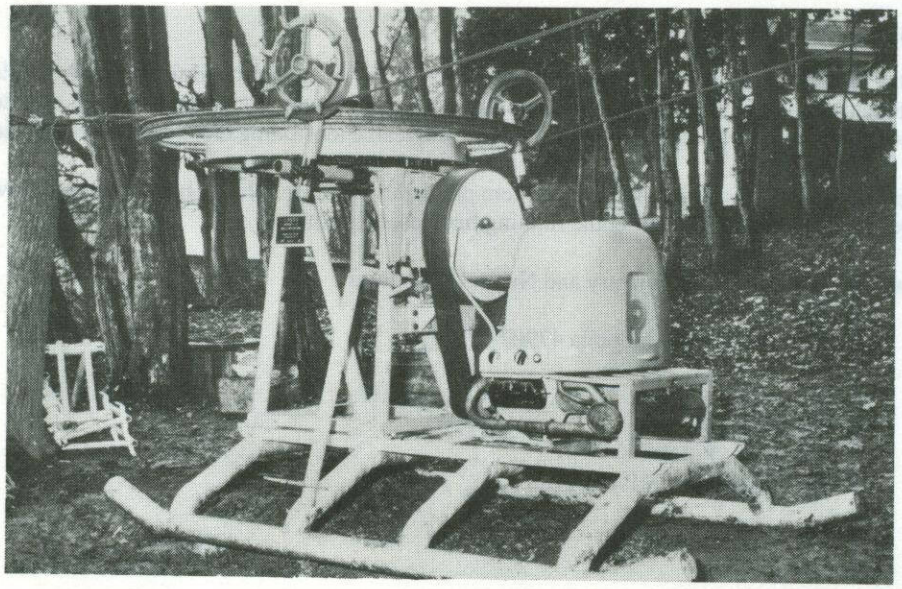
Many circulating monocable systems have been developed for wood harvesting since the 1940's, such as the "Hozlift" and "Paternoster" systems, but only one company, Lasso Technik AG of Basel, Switzerland, is actively marketing the systems worldwide.

LASSO CABLE CONVEYORS

"Lasso" offers several basic systems and many variations of those systems ranging from temporary installations designed for carrying small forest thinnings to large semi-permanent installations for long distance transport of heavy logs or construction materials (with distances up to 6 miles/section and capacities up to 250 tons/hour) over rugged mountain terrain. Only temporary cable conveyors for transporting thinnings and logs of one ton (2200 lbs.) or less will be discussed.



An example of four layout patterns of a "Lasso" cable conveyor from a single landing and driving point. (Courtesy Lasso Technik AG)



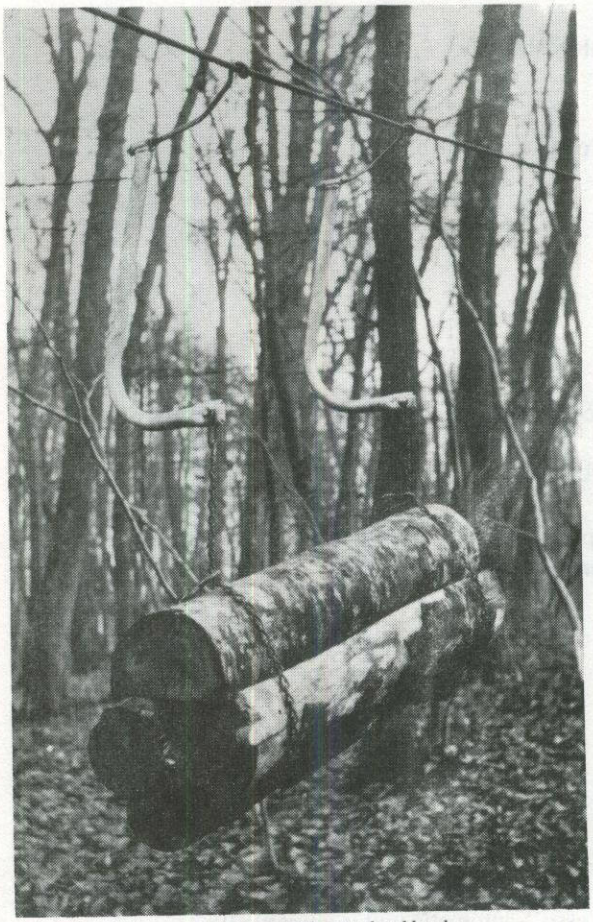
A "Lasso" driving unit. (Courtesy Lasso Tecknik AG)

These light systems are laid out as large irregular loops through the forest with the cables suspended only a few meters above the ground, and supported by pivoting, spiked sheaves attached to trees by brackets. The sheaves are spaced at 40 to 60 meter (130 to 200 ft.) intervals with longer spans over ravines where the cable can be allowed to sag.

Generally the cableway runs clockwise, but with careful erection it can be reversed, thus keeping the transport of loads primarily downhill over the shortest route. Slopes of up to 60 degrees are acceptable for downhill yarding, but 20 degree slopes are the maximum for uphill transport.

Loads are suspended beneath the moving cable with simple U-shaped hooks and chains. These load hooks are designed to pass over the spiked support sheaves. The space between the spikes on the sheaves allows the hooks to pass, while the spikes keep the cable from jumping off.

Loading may take place anywhere along the cableway. For shortwood, the cable may be simply pulled within reach of the ground by a sheave attached to a tirfor (come-a-long) and the pieces hooked one at a time directly onto the moving cable. Bundles of shortwood and longer logs require either two or four hooks per load, thus they must be prepared on a temporary loading platform, and the cable must be stopped each time a load is attached. Usually a rythm develops between loading in the forest, and unloading at the valley station (landing) so that loads are attached each time the cableway stops for unloading. The empty load hooks are returned in bunches on the outgoing side of the cableway.



A bundle of shortwood suspended by two load hooks.

A support sheave and bracket.

(Courtesy Lasso Tecknik AG)

The endless cableway, which can be as long as 10,000 meters (33,000 ft.) around its complete circuit, is powered by a friction drive unit near the unloading point. Since the cableway usually transports loads downhill, the skid mounted drive unit requires a relatively small engine for power. If desired, the "Lasso" drive unit may be equipped with remote controls operated from the unloading site. A standard farm tractor may also be used as a cable drive unit, by blocking up the rear axle, removing a rear wheel rim, and substituting a specially designed cable drive wheel. As with the skid mounted drive unit, the tractor must be securely anchored against the tension on the cableway.

Erection of an endless "Lasso" cable conveyor requires a great deal of planning. All trees necessary for attaching support brackets, and angle change sheaves must be marked to save prior to any cutting. Once cutting is completed, the wood must be piled at selected loading sites along the planned route of the cableway. Then the brackets, support sheaves, and angle change sheaves are distributed, the driving unit is positioned and anchored, and the unloading site is prepared. A portable winch is employed to pull the operating cable around the layout, and sections are spliced where necessary. Once all the components are in place, the cableway is run without load and the necessary adjustments are made. The set-up is a slow and painstaking process requiring an average of 5 crew days (6 man crew) for each 1000 meters (3300 ft.) of cableway.

The "Lasso" cable conveyors offer several advantages for moving timber:
- -no cleared logging corridor is needed
- -an irregular route can be followed
- -it can pass safely under power lines
- -there is virtually no residual stand damage or soil disturbance
- -low power input
- -relatively low investment in relation to yarding distance capabilities

But also there are disadvantages with the "Lasso" system:
- -time consuming and painstaking erection
- -large amount of manpower required: 6-10 man crew
- -no side yarding capabilities, wood must be moved to the cableway

General Data - "Lasso" Cable Conveyor

Operating range (maximum): 10,000 meters (33,000 ft.) around complete circuit

Wire rope sizes:
Light system: 12 mm (½")
Heavy system: 16 mm (⅝")

Line speed: 65 meters/minute (210 fpm)

Load capacities:
Light system: with one sheave per support and loads spaced at 10 meter (33 ft.) or longer intervals
- 50 kg. per load hook (110 lbs.) or
- 100 kg. (220 lbs.) suspended between two hooks

Heavy system: with two sheaves per support and loads spaced at 60 meter (195 ft.) or longer intervals
- 1000 kg. (2200 lbs.) suspended between two, double load hooks

Tower: none

Operator visability:
Of landing: excellent with remote drive unit control

Operator protection: none necessary

Minimum crew size: 1 mechanic/erector as crew foreman
3-4 men for loading
1 man for unloading
1 drive unit operator (eliminated if "Lasso"-automatic unit is employed)

Power source: 5-40 hp. (3.7-30 kW) self contained engine or farm tractor

Drive unit mounting: skids or rear axle of a farm tractor

Cost of system: components for a light system circuit of 2000 meters (6500 ft.) driven from the rear axle of a farm tractor - less tractor and wire rope - f.o.b. European seaport - (April 1978)
$17,600
components for a light system circuit of 6500 meters (21,300 ft.) including "Lasso" drive unit - less wire rope - f.o.b. European seaport - (January 1978) - $49,000

Additional equipment needed for operation:
-wire rope
-radio communications system
-light chains for rigging

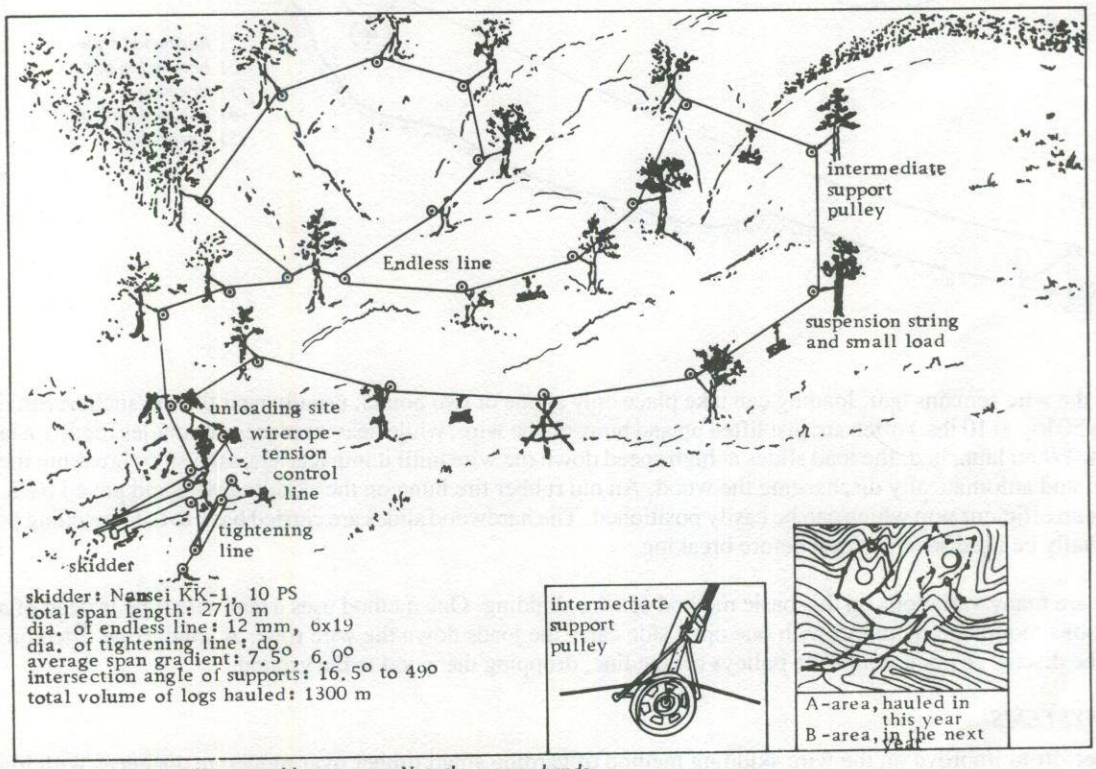
Manufacturer: Lasso Tecknik AG
Guterstrasse 199
CH - 4053
Basel, Switzerland

NANSEI MONOCABLE

The Japanese use a monocable system similar to the "Lasso" system for yarding thinnings and low quality hardwoods. An endless cable drive unit manufactured by Nansei Company moves the cable around a highly irregular circuit.

Unlike the "Lasso" system the cable may make sharp reverse turns. Angle changes at each support sheave must be adequate to maintain pressure against the sheave. The sheaves are not spiked on one side, but they are specially designed to allow passage of the load ropes connected to the monocable.

Normally a 12 mm (15/32") monocable is used on circuits up to 3000 meters (9800 ft.) or longer. Individual load capacities can range up to 200 kg. (440 lbs.) or more depending on support pulley spacing with an average of 10-15 loads being transported per hour when a three man crew is employed (1 yarder operator, 1 hooker, and 1 unhooker).



Layout of a "Nansei" monocable conveyor. Note the reverse bends.

(Courtesy United Nations)

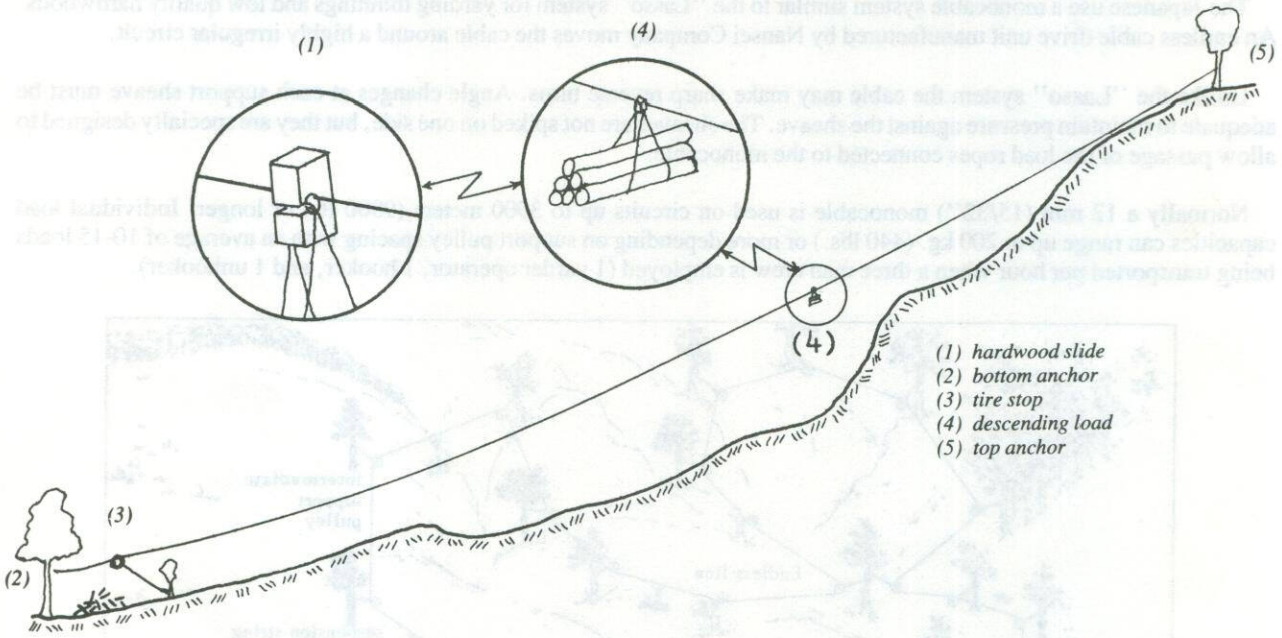
Since the support pulleys are merely attached to trees by slings, and need not be carefully aligned, this system should be quicker and easier to set up than the "Lasso" system. Attaching the loads with ropes is assumed to be slower than load attachment with "Lasso's" convenient hooks.

FREE DESCENT GRAVITY SYSTEMS

WIRE SKIDDING

Wire skidding is an extremely simple method for moving low value shortwood or poles downhill over concave slopes with gradients of 25 to 70%.

A high tensile strength steel wire about 5 mm (3/16") in diameter is stretched taut between anchor points at the top and the bottom of a slope, with maximum distances seldom exceeding 500 meters (1600 ft.). Loads of 200 kg. (440 lbs.) or less are bound with light wire or twine and suspended beneath a wooden slide. The slides can be of varying design. A simple hardwood block with a hole drilled through the middle and a slot in one side serves the purpose well.



Since the wire remains taut, loading can take place only at one or two points, usually near the top anchor. Single pieces less than 50 kg. (110 lbs.) often are just lifted up and hung on the wire, while heavier pieces or bundles require a launching platform. When launched, the load slides at high speed down the wire until it impacts against a stop, breaking the tie wire or twine, and automatically discharging the wood. An old rubber tire hung on the skidding wire and guyed back to a tree serves as an efficient stop which can be easily positioned. The hardwood slides are carried back to the launching point, and can normally be used several times before breaking.

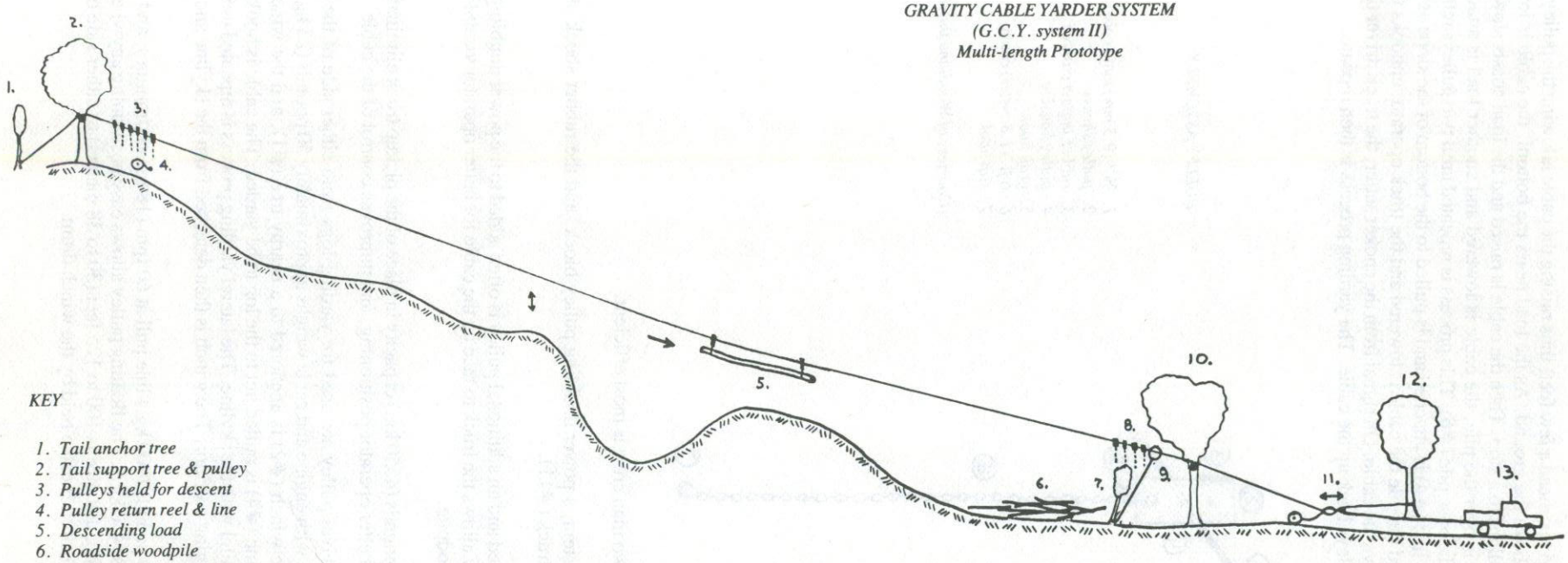
There are many variations on this basic method of wire skidding. One method uses a taut wire rope instead of a smooth wire. Hooks mounted on pulleys with one open side carry the loads down the wire rope. A small cone fitted on the wire rope at the discharge point jumps the pulleys off the line, dropping the wood to the ground.

G.C.Y. SYSTEMS

In an effort to improve on the wire skidding method of yarding small timber over moderate distances with low capital investment, live-skyline G.C.Y. (gravity cable yarding) Systems have been developed by "Woodland Balance" forestry services. There are several variations of G.C.Y. systems, but in all the systems the yarding cable (live skyline) is slacked to the ground for easy attachment of loads anywhere along its span. Three versions of G.C.Y. systems have been successfully tested and a fourth is being developed.

The G.C.Y. System II consists of a single ⅜" (9.5 mm) cable 1000 feet (300 meters) long attached to an anchor tree (see #1. in the illustration on page 45) at the top of a slope and passed through a pulley suspended from a support tree at the top of the slope (#2.) then through a second pulley on a support (#10) tree at the bottom of the slope. The lower part of the cable is attached to a pickup truck, tractor, or winch (#13) which raises or lowers the cable by forward or reverse movement. Excess cable remains on a reel at the bottom. Ten to twenty pulleys, each with a six foot length of chain are suspended from the cable and held for descent by a clamp near the loading point at the upper end of the cable (#3). The cable is lowered to the ground, and a maximum of 1000 pounds (450 kg.) of wood is quickly attached to two pulleys, one at each end of the load, using the chains. Once the load is attached, the choker setter radios a signal from a tiny C.B.

GRAVITY CABLE YARDER SYSTEM
(G.C.Y. system II)
Multi-length Prototype



KEY

1. *Tail anchor tree*
2. *Tail support tree & pulley*
3. *Pulleys held for descent*
4. *Pulley return reel & line*
5. *Descending load*
6. *Roadside woodpile*
7. *Anchor tree for pulley stop*
8. *Pulleys held for return*
9. *Pulley stop*
10. *Base support tree & pulley*
11. *Rubber shock absorber & power doubling pulley*
12. *Anchor tree for power doubling cable*
13. *Pickup truck with C.B. radio*

(Courtesy Woodland Balance)

transceiver to the truck operator who drives ahead a few feet, thus raising the cable allowing the pulleys and load to rapidly descend (#5) completely suspended above the ground. As the load nears the bottom, the cable is lowered until the load comes in contact with the ground and slides to a stop. Then the cable is raised and the load coasts slowly over the roadside woodpile (#6). As soon as each load is over the pile, the cable is lowered and another load is attached while the truck operator unhooks the previous load at the base pile (#6). This process is repeated until two pulleys remain at the upper end of the cable. To these pulleys, a return line (#4) is attached and is pulled to the bottom of the slope as the pulleys and load descend. After the last load has reached the pile the cable is lowered and the truck operator unhooks the load and attaches the return line to the pulley farthest down the cable. On signal from the choker setter, the truck driver tightens the cable and the choker setter winches (#4) the pulleys back up the cable. The yarding process is then repeated.

PULLEY ASSEMBLY

1. ⅜'' (9.5 mm) main cable
2. pulley sheave
3. rubber impact cushion
4. pulley housing
5. grab hook
6. 6 ft. (1.8 meter) chain
7. slip hook

(Courtesy of Woodland Balance)

For all phases of the operation, a two man crew is most efficient.

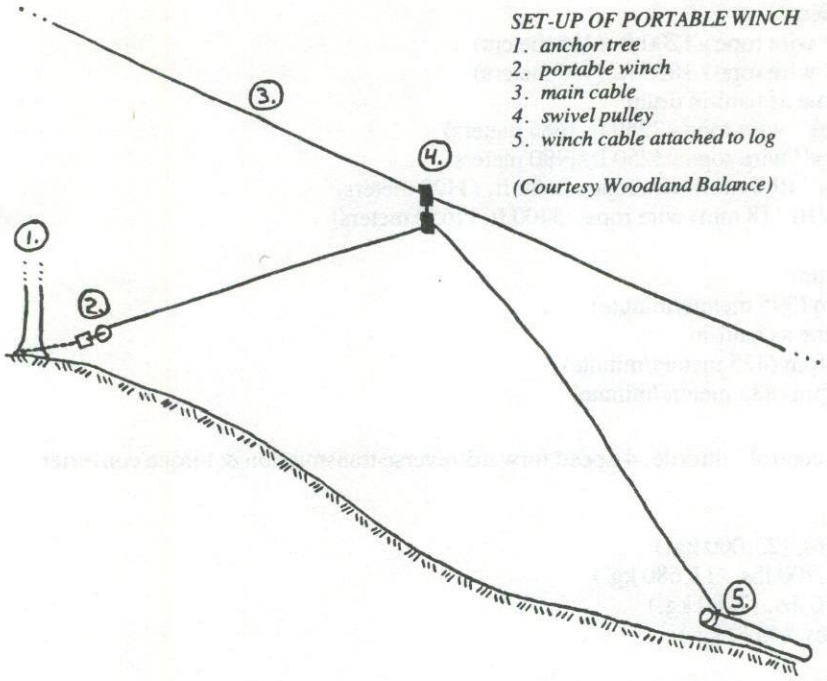
To smooth the operation of the system, a power doubling pulley block, and the rubber shock absorber can be added between the end of the cable and the truck (#11).

Positioning of the truck can be varied and an additional pulley is often added to the power doubling cable (#12) to triple the power. Addition of another pulley allows the truck to face up the cable for better operator visability, and puts the truck in close proximity to the roadside woodpile.

A winch of approximately 10,000 pounds (4550 kg.) capacity in place of the pickup truck eliminates the need for power doubling pulleys or cables, provides better operator positioning, and improves control of the cable.

A portable winch and floating, swivel pulley are used for yarding logs from either side of the logging corridor (see illustration on next page). The winch with engine and cable weighs approximately 50 pounds (23 kg.) and is easily carried by one man. For lateral yarding, the winch (#2) is anchored to a nearby tree (#1), and the winch cable which passes through a floating pulley on the skyline (#4) is pulled out to the log to be yarded. The cable is hooked around the log and winched in until it lies under and parallel with the skyline. The lateral yarding process is repeated until the desired quantity of logs have been yarded into the logging corridor. The winch is then detached from the skyline and the gravity yarding is commenced.

The portable winch develops 2000 pounds (900 kg.) line pull at 60 fpm (18 meters/minute), and is capable of moving logs weighing more than 1000 pounds (450 kg.). The floating pulley allows easy positioning anywhere on the skyline, and provides lift to the logs. Lateral yarding distance is 100 to 125 feet (30 to 38 meters) to either side of the skyline with the 150 feet (45 meters) of 3/16'' (5 mm) aircraft cable held by the winch drum.



SET-UP OF PORTABLE WINCH
1. anchor tree
2. portable winch
3. main cable
4. swivel pulley
5. winch cable attached to log

(Courtesy Woodland Balance)

The G.C.Y. System I is similar to the G.C.Y. System II, except the loads are attached to the pulleys by twine which breaks on impact with the rubber tire stop, discharging the wood into a pile. The G.C.Y. System III uses a hand winch or powered winch of approximately 10,000 pounds (4500 kg.) capacity in place of the pickup truck and the power doubling blocks for tensioning the skyline, a shock absorber is placed between the upper end of the cable (skyline) and the anchor, a load/pulley release allows the skyline to be properly tensioned before the load begins its descent, and the return line (haul-back) reel is placed at the bottom of the slope with the haul-back line running through corner blocks at the back of the setting. The G.C.Y. System IV which is still being developed will use intermediate skyline supports for long distance yarding, the tensioning winch will be placed at the upper end of the cable to slacken only the upper span for attaching loads, and self-releasing choker chains will automatically discharge wood at the landing.

Systems developed by: Woodland Balance
R.D. 1
Woodstock, Vermont 05091

LARGE MOBILE YARDERS

SKYLOK 78

The "Skylok 78" resembles a crane with a short, rugged boom and three over-sized winch drums. The upper unit pivots on a tracked undercarriage that can propel the yarder at speeds up to 9 miles per hour (15 kmh.). Two hydraulically controlled guyline drums allow the yarder to swing or move along the edge of a clear cut while remaining securely guyed. The yarder's ability to swing enables it to place turns of logs on narrow roadways. Interlocking haul-in and haul-back drums as well as a slack pulling make this an excellent yarder for running skyline and grapple logging.

Although the "Skylok 78" can yard laterally at distances up to 45 meters (150 ft.) with a slack pulling carriage, it is too expensive and high powered to be used thinning small timber.

Since mid-1973 a "Skylok 78" has been teamed with a "Morbark Chiparvester" on WESTVACO whole tree harvesting operations in the Virginias.

General Data - "Skylok 78":

Operating range: depends on the allowable line deflection on each logging corridor
with ⅝" (16 mm) haul-in & ¾" (19 mm) haul-back - 1100 ft. (335 meters)
with ½" (13 mm) haul-in & ⅝" (16 mm) haul-back - 1600 ft. (490 meters)

Winch drum capacities:
Haul-in: with ⅝'' wire rope - 1200 ft. (365 meters)
with ½'' wire rope - 1800 ft. (550 meters)
Slack-pulling: same as haul-in drum
Haul-back: with ¾'' wire rope - 2250 ft. (685 meters)
with ⅝'' wire rope - 3250 ft. (990 meters)
Strawline: with ⅜'' (9.5 mm) wire rope - 3680 ft. (1120 meters)
with 5/16'' (8 mm) wire rope - 5400 ft. (1650 meters)

Line speeds: mid-drum
Haul-in: 1300 fpm (395 meters/minute)
Slack-pulling: same as haul-in
Haul-back: 1400 fpm (425 meters/minute)
Strawline: 2900 fpm (885 meters/minute)

Line speed & power control: throttle, 4-speed forward/reverse transmission & torque converter

Line pull: mid-drum
Haul-in: 50,600 lbs. (23,000 kg.)
Slack-pulling: 25,700 lbs. (11,680 kg.)
Haul-back: 15,800 lbs. (7180 kg.)
Strawline: 9500 lbs. (4320 kg.)

Guylines: 2-¾'' wire ropes, 150 ft. (45 meters) long

Tower:
Height: 45 ft. (13.7 meters)
Construction: inclined, heavy, lattice steel, A-frame
Erection: cable or hydraulic

Weight: with wire ropes - 88,500 lbs. (40,200 kg.)

Controls: Excellent - enclosed cab
Winch clutches & brakes: air activated

Operator visability:
Of landing: excellent
Of winch drums: good

Operator protection: excellent

Minimum crew size: 1 yarder operator
2 choker setters
1 chaser

Power source: 197 hp. (147 kW) diesel engine

Mounting: tracked undercarriage

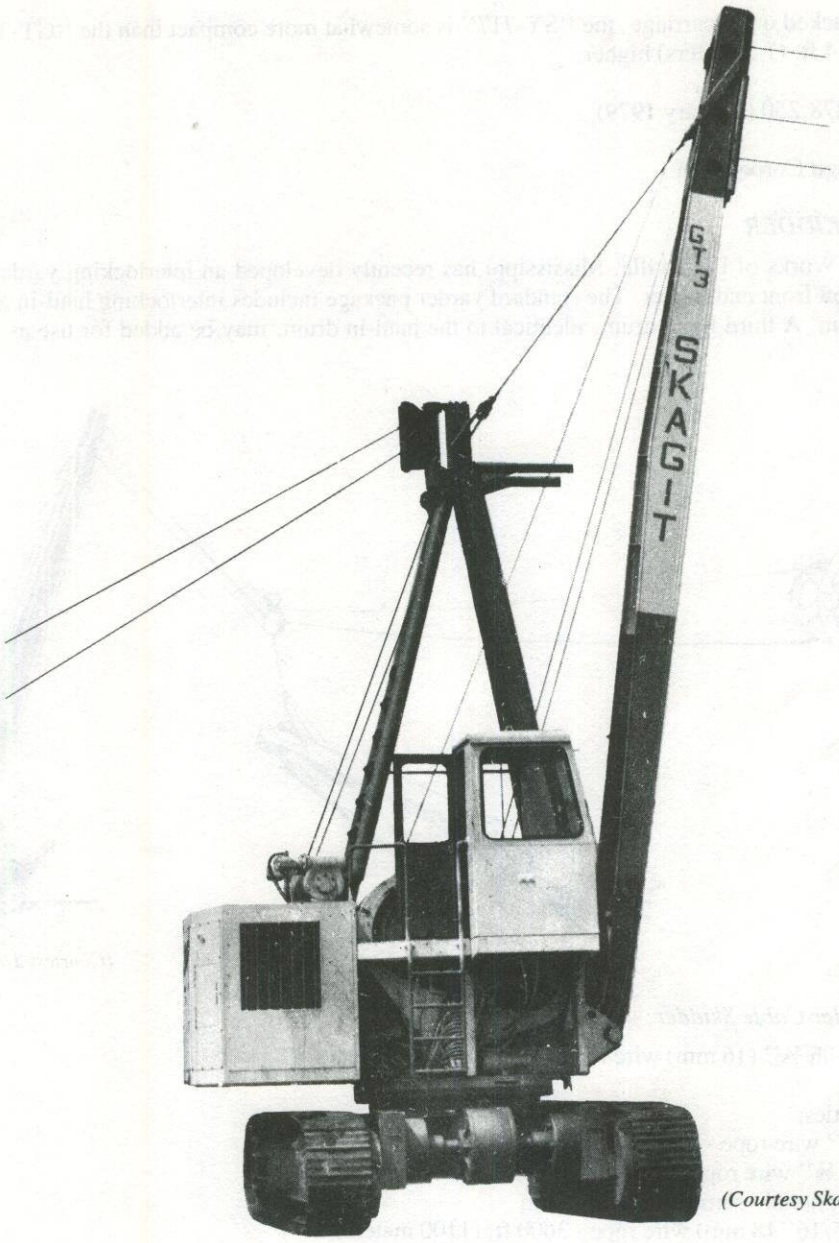
Skyline carriage: not supplied - purchaser's choice of slack-pulling, non slack-pulling, or grapple

Cost of yarder: $245,000 (January 1979)

Additional equipment needed for operation:
-running skyline carriage or grapple
-radio communications system

Manufacturer: Washington Iron Works
1500 Sixth Avenue South
Seattle, Washington 98134

SKAGIT GT-3



(Courtesy Skagit Corporation)

The "Skagit GT-3" interlocking yarder is very similar in design and performance to the "Skylok 78". One major difference is the choice of a tracked or rubber-tired undercarriage for the GT-3. The rubber-tired undercarriage can propel the "GT-3" at speeds up to 18 mph (30 kmh).

Cost of yarder: $402,740 (January 1979)

Manufacturer: Skagit Corporation
P.O. Box 151
Sedro-Wooley, Washington 98284

SKAGIT SY-717

The "SY-717" interlocking yarder is a new machine developed by Skagit Corp. It has operating characteristics similar to the "Skagit GT-3" and the "Skylok 78". Maximum yarding distances are about 1200 ft. (365 meters) when the haul-in, haul-back, and slack-pulling drums are rigged for running skyline yarding with ⅝" (16 mm) wire rope. An optional skyline drum with a capacity of 1800 ft. (550 meters) of ¾" (19 mm) wire rope is available.

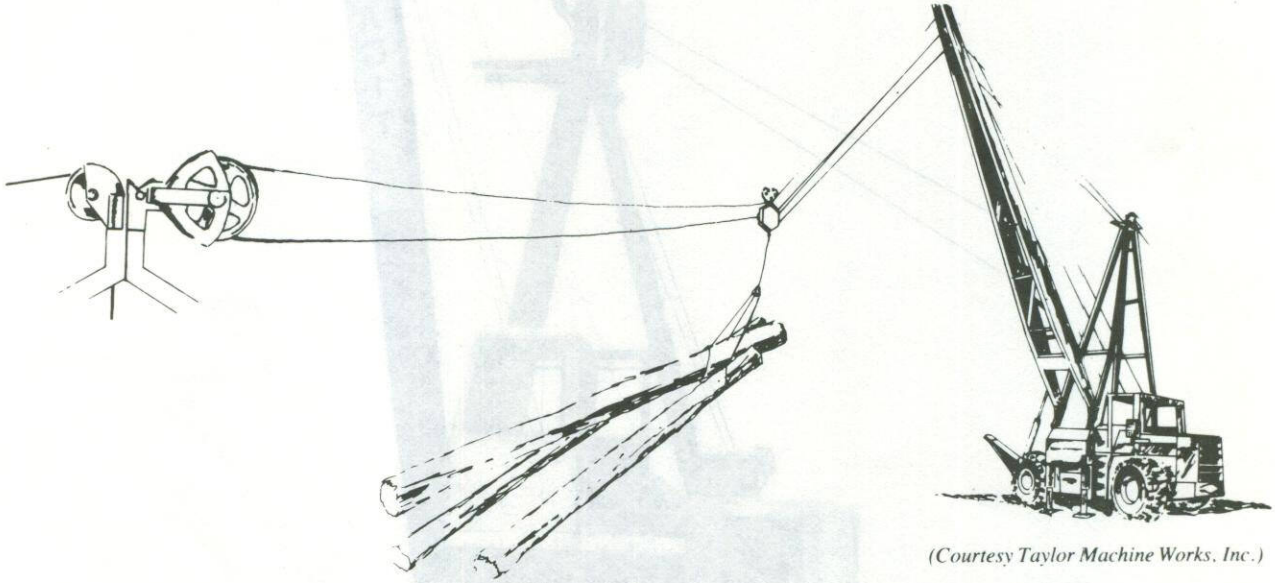
Mounted on a tracked undercarriage, the "SY-717" is somewhat more compact than the "GT-3", although its 49 ft. (15 meter) tower is 4 ft. (1.2 meters) higher.

Cost of yarder:- $278,250 (January 1979)

Manufacturer: Skagit Corporation

TAYLOR CABLE SKIDDER

Taylor Machine Works of Louisville, Mississippi has recently developed an interlocking yarder which mounts on a Taylor, model T-958 front end loader. The standard yarder package includes interlocking haul-in and haul-back drums, and a strawline drum. A third large drum, identical to the haul-in drum, may be added for use as a slack puller or as a grapple opener.



(Courtesy Taylor Machine Works, Inc.)

General Data - Taylor Cable Skidder:

Operating range: with ⅝" (16 mm) wire rope - 1200 ft. (365 meters)

Winch drum capacities:
- Haul-in: with ⅝" wire rope - 1250 ft. (380 meters)
- Haul-back: with ⅝" wire rope - 2500 ft. (760 meters)
- Slack-pulling: Optional - same as haul-in drum
- Strawline: with 5/16" (8 mm) wire rope - 3600 ft. (1100 meters)

Line speeds:
- Haul-in: 1350 fpm (410 meters/minute)
- Haul-back: same as haul-in
- Slack-pulling: Optional - same as haul-in
- Strawline: 2000 fpm (610 meters/minute)

Line speed & power control: throttle, 4-speed forward/reverse transmission, & torque converter

Line pull:
- Haul-in: 30,000 lbs. (13,600 kg.)
- Haul-back: 13,000 lbs. (5900 kg.)
- Slack-pulling: Optional - same as haul-in
- Strawline: 8,000 to 12,000 (3640 to 5450 kg.)

Tower:
- Height: 55 ft. (16.8 meters)
- Construction: inclined, heavy lattice steel, A-frame
- Erection: hydraulic

Weight: with wire ropes - 65,000 lbs. (29,550 kg.)

Controls: ? excellent ? - enclosed cab
Winch clutches & brakes: hydraulic & air

Operation protection: excellent ·

Minimum crew size: 1 yarder operator
1 chaser
2 choker setters

Power source: Model T-958 loader engine

Mounting: on Model T-958 front end loader

Skyline carriage: not supplied - purchaser's choice of running skyline carriages or grapples

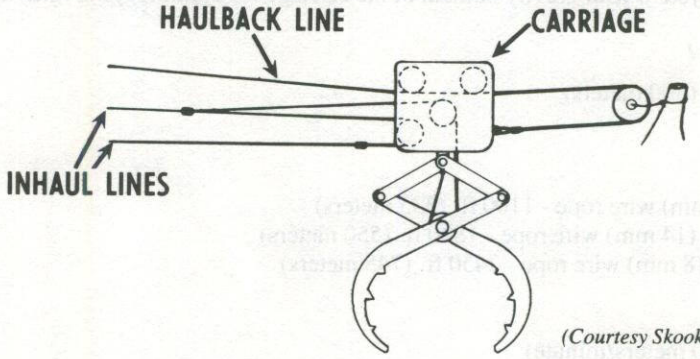
Cost of yarder: not available

Additional equipment needed for operation:
-running skyline carriage or grapple
-radio communications system

Manufacturer: Taylor Machine Works, Inc.
P.O. Box 150
Louisville, Mississippi 39339

GRAPPLE YARDING

Three drum interlocking yarders may be rigged for grapple yarding. Line configuration for grapple yarding is similar to that for a running skyline equipped with a slack pulling carriage. The slack pulling line is used to open the grapple then the tension between the haul-in and the haul-back lines is reduced lowering the grapple over a log. Once the grapple is positioned, the jaws are closed, tension is applied to the interlocking haul-in/haul-back lines, and the grapple is rapidly hauled into the landing with a single log turn.



(Courtesy Skookum Co.)

Crew requirements for this system are minimal. Only a yarder operator and a spotter are needed. The spotter stands safely out of the way and radios instructions to the yarder operator so that he may position the grapple over a log. Night yarding with grapple systems has been tried with good success.

Since grapple yarding systems have no lateral yarding capabilities, they are suited only for harvesting clear-cuts. The swing of the yarder boom aids in positioning the grapple over logs, but frequent changes of the logging corridor are still necessary. The changes can be facilitated by using a mobile tailhold at the rear of the setting such as an old crawler tractor rigged with a small tower. Although grapple yarding saves on labor costs, the high cost of an interlocking swing yarder, and the inability of the grapple to yard more than one log per turn, precludes its use for harvesting small, low value timber.

CONVERTED CRANES

To reduce investments in specialized logging machinery, cranes are often converted for use as yarders (jammers). The high boom is replaced by a shorter, more rugged boom, and winch drums are added or modified as necessary to turn the machine into a double drum yarder. If the timber is small and the machine well stabilized, guylines need not be added.

Line speeds and drum capacities are often low for these converted cranes, thus yarding distances seldom exceed 150 meters (500 ft.). Cable configurations used can be a live skyline with gravity outhaul (gravity slackline), highlead, highlead with a squirrel block, or a non-interlocking (two part) running skyline.

The ability of these machines to swing greatly facilitates the placing of logs on a haul road or landing.

WEST COAST MOBILE TOWER

As the name implies, this yarder was built to log heavy West Coast timber yet be compact and mobile. The yarder unit is mounted across a 239 hp. (178 kW) Terex crawler with a 49 ft. (15 meter) telescoping tower on one side. Yarder dimensions are 13.5X13.5 ft. (4.1X4.1 meters), thus allowing it to be transported over the highway as an oversized load with the tower removed.

Designed as a live skyline yarder, the "Mobile Tower" can also be rigged for highlead and gravity outhaul systems with lateral yarding capabilities.

Distributor: Interstate Tractor Co.
Portland, Oregon

ECOLOGGER I

A 130 h.p. (97 kW) skidder serves as the power plant and carrier for the "Ecologger's" yarding drum set and 42 ft. (12.8 meters) hydraulicly raised tower. There are main winch drums for the haul-in (mainline) and haul-back lines plus a smaller drum for the strawline. Four small hydraulically driven guyline drums are mounted near the base of the tower.

When erected, the tower sits directly on the ground on a heavy steel base pad. Operation of the yarder can be remotely controlled by radio or by optional manual controls in the cab. With radio controls the chaser can double as the yarder operator and can position himself for good visability down the logging corridor. On production trials in the U.S. and Canada the radio controls proved unreliable, thus operation with manual controls was recommended.

As with all double drum yarders, the "Ecologger" can be rigged as a highlead, non-interlocking, running skyline (two part line), or live skyline system with gravity outhaul of the carriage for uphill logging (gravity slackline).

General Data - Ecologger I

Operating range: 1000 ft. (300 meters)

Winch drum capacities:
Haul-in: with ¾" (19 mm) wire rope - 1100 ft. (335 meters)
Haul-back: with 9/16" (14 mm) wire rope - 1800 ft. (550 meters)
Strawline: with 5/16" (8 mm) wire rope - 2450 ft. (745 meters)

Line speeds:
Haul-in: 1000 fpm (300 meters/minute)
Haul-back: 1000 fpm (300 meters/minute)
Strawline: 600 fpm (180 meters/minute)

Line speed & power control: throttle, 3-speed forward/reverse transmission, & torque converter

Line pulls:
Haul-in: 30,000 lbs. (13,600 kg.)
Haul-back: same as haul-in
Strawline: mid-drum - 1800 lbs. (800 kg.)

Guylines: 4, with ¾" (19 mm) wire rope X 200 ft. (60 meters)

Tower:
Height: 42 ft. (12.8 meters)
Construction: 12X12 inch box steel
Erection: hydraulic

Weight: less wire ropes - 31,000 lbs. (14,100 kg.)

Controls: radio controls are unreliable (1977)
Manual controls ?
Winch clutches & brakes: cone clutch & air brakes

Operator visability: with radio controls
Of landing: excellent
Of winch drums: fair to poor

Operator protection:
With radio controls: none - operator stands clear of cables and yarder
With manual controls: excellent

Minimum crew size:
With radio controls: 1 chaser/operator
1 choker setter
With manual controls: 1 yarder operator
1 chaser
1 choker setter

Power source: 130 h.p. (97 kW) diesel engine in skidder

Mounting: Tree Farmer C7D skidder

Cost of system: ? $120,000 ? (1978)

Additional equipment needed for operation:
-carriage for slackline and skyline operation

Manufacturer: Rosedale Machinery Sales, Ltd.
9888 Munro Avenue
P.O. Box 100
Rosedale, British Columbia
VOX 1X0

TIMBER TOWER

Like the ''Ecologger I'', the ''Timber Tower'' is designed for mounting on the rear of a skidder, but is equipped with a skyline drum in addition to haul-in, haul-back, and strawline drums. Thus several yarding systems may be used.

Most makes of skidders with the arch and fairlead removed, are suitable for mounting the ''Timber Tower'', but the rear frame must be extended, a platform added for supporting the drum set, and dual wheels fitted to the rear axle. Power for the yarder is supplied by the skidder engine.

The 55 foot (16.8 meter), tubular steel tower is stabilized by four guylines tensioned by powered winches at the tower base. A large steel pad on which the tower rests and two hydraulic outriggers at the rear of the skidder provide further stability.

Dealer: Cascade Logger's Supply
Chehalis, Washington 98532

M.A.C. THUNDERBIRD

Equipped with a skyline drum, two skidding drums (haul-in & slack-pulling), a haul-back drum, and a strawline drum, the ''M.A.C. Thunderbird'' allows a variety of logging systems to be rigged.

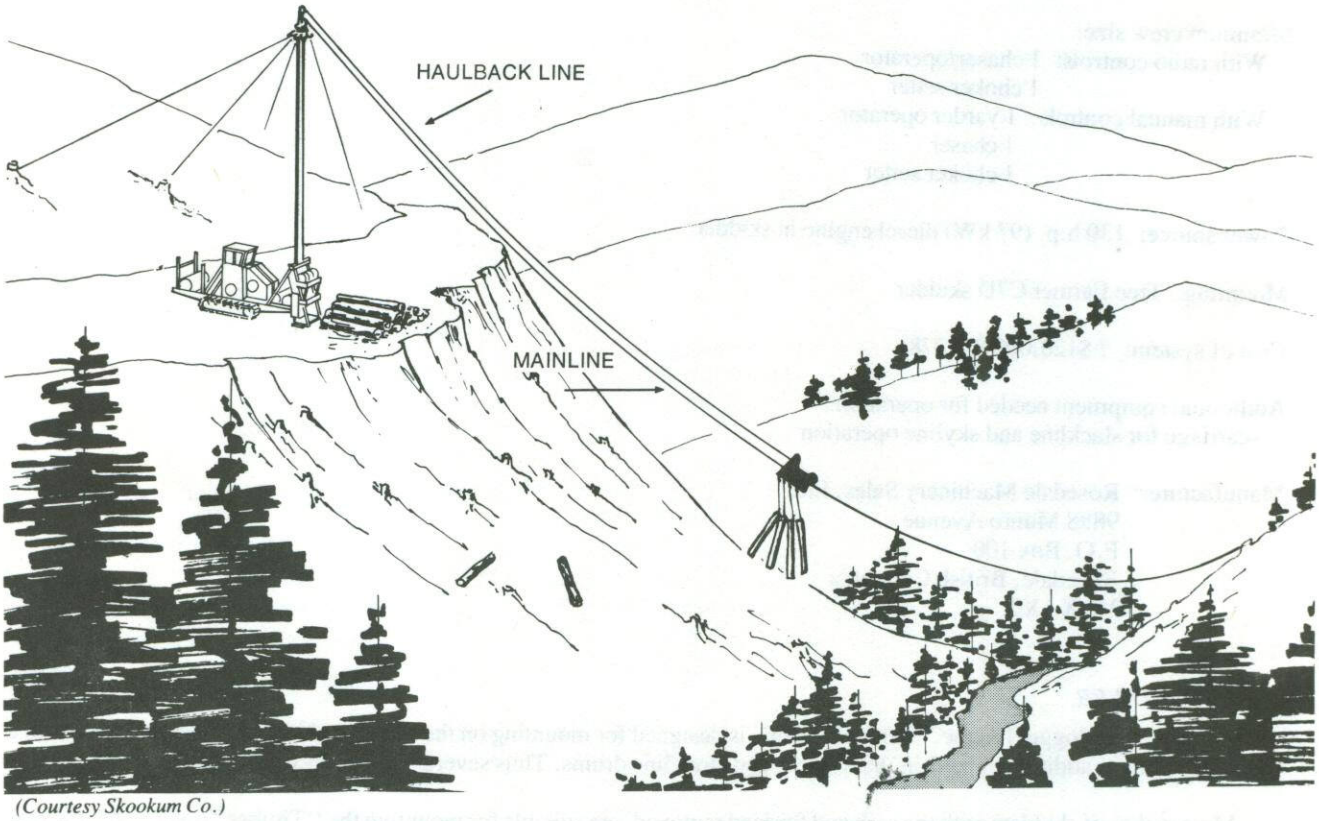
The yarder is mounted crossways on a lowboy trailer which is pulled by a truck tractor. With the tower folded over the gooseneck, it can be transported fully rigged. The tower is erected hydraulically, and the unit is stabilized by 4 hydraulic pads and 3 guylines.

Distributor: Ross Equipment, Inc.
P.O. Box 2589
Eugene, Oregon 97402

Manufacturer: M.A.C. Machinery Co.
6239 Corson Avenue South
Seattle, Washington 98108

LIVE SKYLINES

Instead of the skyline remaining taut, a live skyline (slackline) is slackened to lower the carriage for hooking logs. Often a skyline carriage with fixed chokers is employed, and the skyline is tightened and lossened to control the height of the carriage and turns above the ground as they are yarded in.

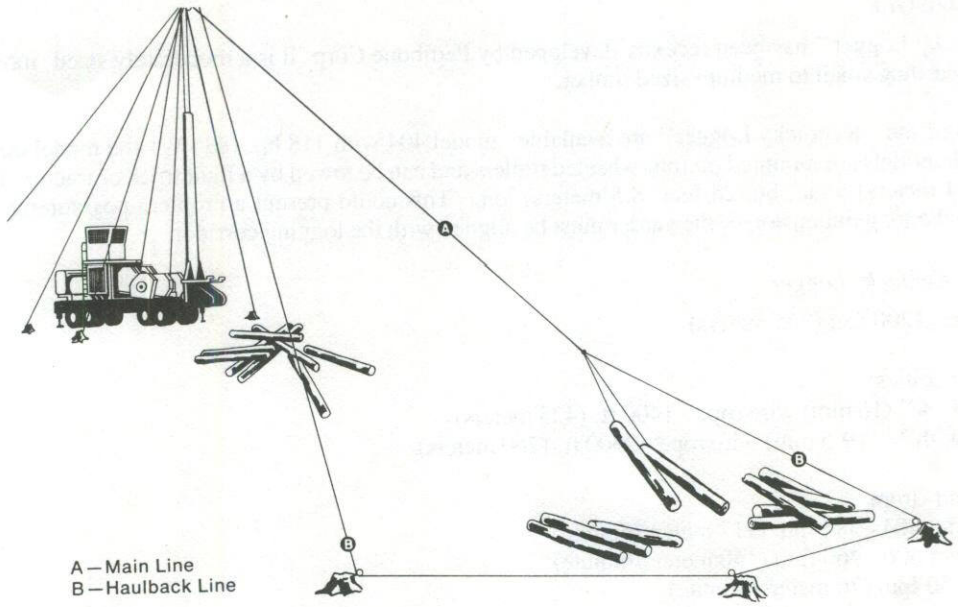


(Courtesy Skookum Co.)

Double drum yarders may be rigged as live skyline systems with gravity outhaul of the carriage for uphill logging (gravity slackline). A heavy carriage rides on the haul-in (mainline) which is anchored to a tailhold and serves as the live skyline. The haul-back line is attached to the carriage and becomes the haul-in. A non-interlocking double drum yarder using this system can lift turns off the ground, thus reducing soil disturbance and increasing yarding speeds in comparison with a highlead system. No skyline supports can be used, thus limiting maximum yarding distances to a single clear span.

HIGHLEAD YARDERS

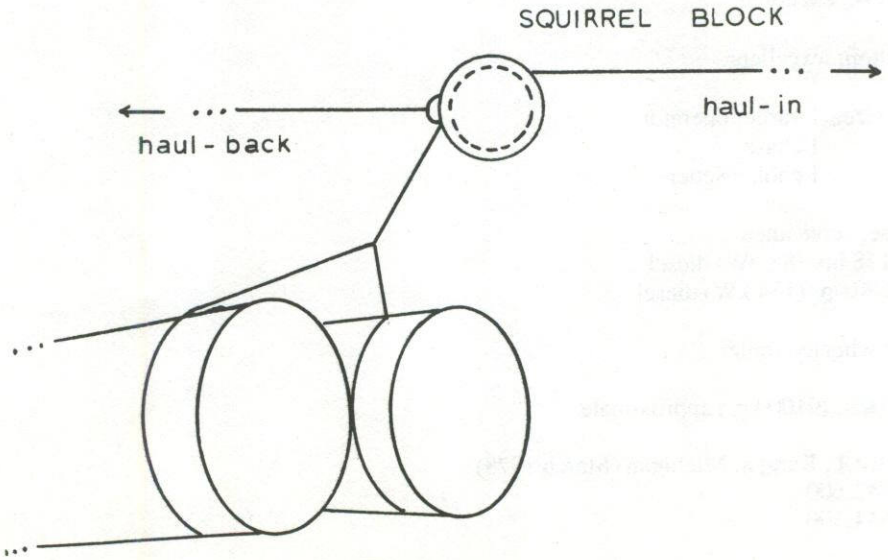
Highlead is the most common method of cable logging in the Pacific Northwest. It is simple to rig, can be used on uphill and downhill settings, and can be powered by virtually any two drum yarder.



(Courtesy Skagit Corporation)

A mainline (haul-in line) hauls in the logs to the landing, and a haul-back line returns the mainline to the point where the chokers are being set. The mainline is elevated by a fairlead at the top of the yarder tower or by a block hung in a spar tree at the landing; this provides lift to the turn of logs being yarded. Unlike skyline systems, the lift on a turn decreases with increasing distance from the yarder tower or spar tree, until a point is reached where no lift is applied. Beyond this point the system functions as a ground-lead with the attendant problems of hang-ups and soil disturbance. Tower or spar tree height, terrain, and haul-back tension all influence the distance at which lift is applied to the turns. Uphill yarding is preferred since lift is applied over a longer yarding distance.

The heavy West Coast highlead systems generally use fixed chokers attached to a butt rigging between the ends of the haul-in and haul-back lines. To gain limited lateral yarding capabilities, the smaller highlead systems often employ a squirrel block attached to the end of the haul-back line. The haul-in, equipped with one or more chokers, passes through the squirrel block and may be pulled out to either side of the logging corridor.



Highlead systems are not well suited to thinning operations or selective harvests since unwanted lateral movements of the cables and turns can not be prevented as the logs are yarded toward the landing. Even when used in clear-cuts, high-powered highlead systems often cause severe soil and stream disturbance especially in downhill yarding where little lift is applied to the turns.

KENTUCKY LOGGER

The ''Kentucky Logger'' has been recently developed by Pettibone Corp. It is a moderately sized, moderately priced unit suited for yarding small to medium sized timber.

Two models of the ''Kentucky Logger'' are available: model 404 with 118 hp. (88 kW) and model 606 with 180 hp. (134 kW). Both models are mounted on four wheeled trailers and can be towed by a light truck or tractor. The yarders are only 8 feet (2.4 meters) wide, but 28 feet (8.5 meters) long. This could present a problem positioning them on small landings, since the long dimension of the yarder must be aligned with the logging corridor.

General Data - Kentucky Logger

Operating range: 1200 feet (365 meters)

Winch drum capacities:
Haul-in: with ⅝'' (16 mm) wire rope - 1400 ft. (425 meters)
Haul-back: with ⅜'' (9.5 mm) wire rope - 2500 ft. (760 meters)

Line speeds: mid-drum
Haul-in: model 404 - 384 fpm (117 meters/minute)
model 606 - 460 fpm (140 meters/minute)
Haul-back: 250 fpm (76 meters/minute)

Line pull: mid-drum
Haul-in: model 404 - 7000 lbs. (3200 kg.)
model 606 - 8000 lbs. (3600 kg.)

Line speed & power control: hand throttle - ? transmission ?

Guylines: 4 tower brackets available for attaching guylines

Tower:
Height: 35 ft. (10.7 meters) - optional towers available to 65 ft. (20 meters)
Construction: lattice steel A-frame
Erection: cable

Operator visability:
Of landing: excellent
Of winch drums: excellent

Operator protection: excellent

Minimum crew size: 1 yarder operator
1 chaser
1 choker setter

Power source: self-contained
Model 404: 118 hp. (88 kW) diesel
Model 606: 180 hp. (134 kW) diesel

Mounting: four-wheeled trailer

Weight: 20,000 lbs. (9100 kg.) approximate

Cost of yarder: f.o.b. Baraga, Michigan (March 1978)
Model 404: $42,600
Model 606: $44,100

Optional equipment:
-enclosed, heated cab
-self-propulsion

Additional equipment needed for operation:
-radio communications system
-truck or tractor for towing

Manufacturer: Pettibone Michigan Corporation
P.O. Box 368
Baraga, Michigan 49908

BIG STICK HIGHLEAD

In the late 1950's a highlead yarding attachment was developed for the "Big Stick" truck mounted loader used on pulpwood operations in the southern U.S.

The "Big Stick" is a small, rigid-boom, cable loader mounted on a swivel elevated above the middle of the cargo bed of a medium sized truck. A 400 ft. (120 meters) × 5/16" (8 mm) haul-in cable runs from a winch through a sheave on the end of the loader boom and is pulled into the woods by a haul-back line. The haul-back runs through a tail block and a corner block, back through an elevated fairlead on the rear of the truck, and down to the haul-in winch.

Bundles of 4 to 8 ft. (1.2 to 2.4 meters) pulpwood are yarded from the woods in conventional highlead fashion to the truck parked on a haul road. Then instead of being dropped on a landing, the pulpwood bundle is winched right up to the boom and swung over either the front or back bay on the truck where it is lowered into position. When the truck is fully loaded the haul-in and haul-back lines are disconnected and winched in. Upon return of the empty truck, 10-15 minutes are required to re-rig the cable yarding system.

A three man crew is the most efficient. The operator sits on top of the truck cab while a top loader works in the front or rear bay arranging the load. In the woods a chokerman attaches the bundles to the haul-in line. While the truck is gone with a load, the top loader and chokerman cut or bunch more pulpwood for yarding.

With the advent of hydraulic knuckle-boom loaders the use of "Big Stick" loaders has declined, but the concept may be of interest to small fuelwood operators who wish to minimize their investment in a complete harvesting system.

Manufacturer: Brown Machinery Service
Louisville, Mississippi

Remarks: It is not known if this company still manufactures the "Big Stick".

NORDFOR TILT WINCH with HAUL-BACK

Nordfor Teknik AB of Sweden offers a radio controlled thinning winch for mounting on a skidder or forwarder. The "Tilt Winch" mast which rises about 3 meters (10 ft.) above the ground, can be tilted forward or backward by remote control, 2.5 meters (8 ft.) from the vertical. This aids in freeing turns of thinnings from hang-ups and in decking. Once the thinnings are bunched beside the skid trail, they are pulled up to the skidder butt plate by the main winch or piled on the back of a forwarder with a hydraulic loader.

By adding a haul-back drum, the "Tilt Winch" becomes a mini-highlead yarder with remote radio controls. Both the chokerman and chaser are supplied with radio control units, but a safety feature allows only one control to operate at a given moment.

General Data - Tilt Winch with Haul-back:

Winch drum capacities:
Tilt Winch: with 7 mm (9/32") wire rope - 250 meters (800 ft.)
Haul-back: with 4 mm (5/32") wire rope - 800 meters (2600 ft.)

Line pull:
Tilt Winch: 1500 kg. (3300 lbs.)
Haul-back: 400 kg. (880 lbs.)

(Courtesy Nordfor Teknik AB)

Line speed: Tilt Winch
Infeed: 36 meters/minute (118 fpm) or 72 meters/minute (236 fpm)
Outfeed: up to 300 meters/minute (980 fpm)

Manufacturer: Nordfor Teknik AB
Box 30
S - 776 02
Vikmanshyttan, Sweden

GROUND LEAD SYSTEMS

Any double drum winch unit not equipped with a tower may be rigged for ground lead yarding. The haul-in and the haul-back lines are arranged in the same fashion as for a conventional highlead system, but the lines are not elevated off the ground. This system provides no lift to the turns, thus there are frequent hang-ups resulting in low yarding speeds. Yarding distances are severely limited by the roughness of the terrain or any obstacle that may be encountered along the logging corridor such as stumps or residual trees. Also soil disturbance is the highest for any of the cable systems and it is not well suited for extracting thinnings.

Since it is usually quite a simple matter to hang a block up a tree or erect a tower to provide lift, the ground lead system is seldom used.

CHUBALL

The "Chuball" system is a unique, ground lead logging method developed by Forest Service research engineers. Designed primarily for uphill logging, the "Chuball" is a 5 ft. (1.5 meter) steel ball weighing 3000 lbs. (1360 kg.) which rolls downhill into the woods guided by a taut cable. The guide cable runs from a winch on the yarder, through the middle of the "Chuball" and is attached 2-4 ft. (1 meter) up a tail tree at the far end of the logging corridor. A ⅝" (16 mm) wire rope serving as a haul-in also passes through the middle of the ball and is used for lateral yarding. The "Chuball" applies a slight lift to the turns of logs, reduces hang-ups, and can operate on steep slopes. For logging on level ground, the "Chuball" can be rigged with a haul-back, thus requiring a three drum yarder. A double drum winch mounted on the rear of a skidder served as the yarder for uphill logging during design trials.

Yarding distances are limited by terrain with 500 ft. (150 meters) being the maximum. Since the "Chuball" rolls along the ground, it cannot pass through gullies or over rock ledges. Problems are encountered with extreme cable wear, and lateral yarding distances are limited because very little lift is applied to the turns.

After lengthy testing, the "Chuball" concept was abandoned by the Forest Service.

For information, contact: Information Services
Northeastern Forest Experiment Station
Upper Darby, Pennsylvania 19082

CIRCULATING MAINLINE

This system, recently developed in Austria, originally used a wire rope for the circulating line, but now uses a chain with 20 meter (65 ft.) sections. Each section has a moveable choker.

Conifers are felled in the direction of yarding, and into the logging corridor where they are hooked and dragged, top first to the yarder.

Maximum yarding distance is 400 meters (1300 ft.) over smooth terrain with a 10 meter (32 ft.) spacing between logging corridors.

PENDULUM CABLEWAYS

Occasionally pendulum cableways have been used to transport timber from the alpine forests of Europe.

A simple pendulum cableway consists of two parallel carrier cables (skylines) each serving as a support and track for a carriage. A third, traction cable, the same length as the carrier cables, connects the two carriages through a sheave at the upper end of the installation. When one carriage is loaded it descends, pulling the other carriage up. Speed of descent is controlled by a brake on the sheave at the upper end. There are many variations on this principle such as endless traction cables with many carriages pulled around the system by the force of gravity, although power may be added. Lasso of Switzerland makes powered, heavy duty, semi-permanent and permanent installations for transport of materials over long distances.

PREBUNCHING WINCHES RADIO-CONTROLLED

There are innumerable makes and models of small winches which can be employed to bunch thinnings in preparation for yarding by larger machines. Although these winches are not cable systems per se, they can be effectively employed to increase the productive output of both ground and cable yarding systems.

Only a few of the better known radio-controlled winches will be briefly discussed. Radio-controlled winches require only one operator to hook the loads, follow them to the bunching point, unhook, and pull the line back for the next load.

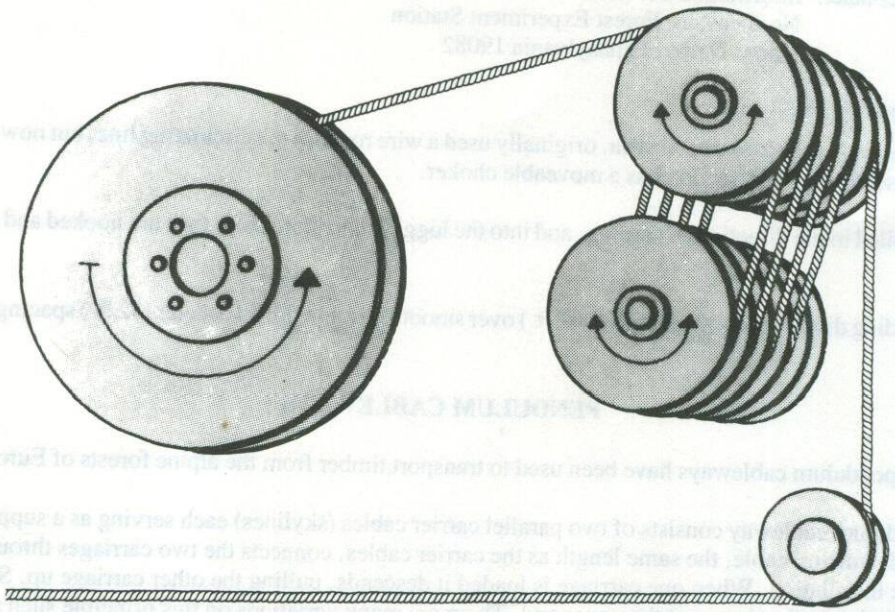
Radio-controlled winches can also be used in conjunction with skyline logging systems to pull out the lateral yarding line (lifting line) on long settings, thus eliminating the need for slack pulling yarder/carriage combinations or extra chokermen.

RADIO-TIR

The ''Radio-Tir'' models 740 and 1200 are light, sled mounted thinning winches powered by 6 hp. (4.5 kW) and 10 hp. (7.5 kW), two-cycle engines. Both models employ a unique winching method to reduce cable wear and ensure smooth operation. Unlike a drum winch which winds the cable up turn after turn squeezing and crushing the underlying wraps on the drum, the ''Radio-Tir'' winches use two multi-grooved drive rollers to feed the cable onto a lightly winding storage reel. This winching system allows a very light cable to be used since it is not subject to damage from winding tightly on a winch drum. Line speed and pull always remain constant and are not affected by the amount of cable on the storage reel. (see illustration on next page)

When the operator radios a signal, the engine throttle opens, and a centrifugal clutch engages the winch. With the engine idling, the drive rollers rotate in reverse. The operator pulls tightly on the line and it feeds out automatically at the speed he walks, stopping when he stops. Only a single function of the radio-control is needed for the complete yarding cycle.

The long cables on the ''Radio-Tir'' winches permit nearly one hectare (about 2 acres) to be yarded without moving the winch. Corner blocks are used to change the path of the cable as desired. When it does become necessary to move, the ''Radio-Tir'' easily winches itself along under the guidance of the operator.



Working principle of "Radio-Tir" winching method.
(Courtesy Klope-Patent AB)

General Data - Radio-Tir:

Line capacity:
Model 740: with 6 mm (¼") wire rope - 150 meters (500 ft.)
Model 1200: with 7 mm (9/32") wire rope - 110 meters (360 ft.)

(Courtesy Klope-Patent AB)

Line pull:
Model 740: 800 kg. (1750 lbs.)
Model 1200: 1200 kg. (2650 lbs.)

Power source:
Model 740: 6 hp. (4.5 kW) 2-cycle engine
Model 1200: 10 hp. (7.5 kW) 2-cycle engine

Weight: including sled and cable
Model 740: 150 kg. (330 lbs.)
Model 1200: 170 kg. (375 lbs.)

Cost of winches: in Sweden (March 1978)
Model 740: $5,900
Model 1200: $7,000

Manufacturer: Klope-Patent AB
Fack
S - 682 01
Filipstad, Sweden

FLYING SAUCER WINCH

Resembling a land based flying saucer, this winch is controlled and functions in a manner similar to the "Radio-Tir" winches. The engine and winch drive components are well protected inside the sturdy, steel saucer shaped skid pan and housing. (photo on next page)

General Data - Flying Saucer Winch:

Cable capacity: with 6.5 mm (¼") wire rope - 125 meters (400 ft.)

Line pull: 1500 kg. (3300 lbs.)

Line speed:
Infeed: 36 meters/minute (120 fpm)
Outfeed: 72 meters/minute (240 fpm)

Power source: 16 hp. (12 kW) gas engine

Weight: 450 kg. (1000 lbs.)

Cost: in Sweden (March 1978) - $7,700

Manufacturer: Nordfor Teknik AB
Box 30
S - 776 02
Vikmanshyttan, Sweden

Remarks: Introduction of the "Flying Saucer Winch" on the North American market is planned soon.

FLYING SAUCER WINCH (Courtesy Nordfor Teknik AB)

SEPSON WINCH

In its broad line of winches, manufactured for a wide variety of uses, Sepson offers a radio-controlled thinning winch mounted on a light sled and enclosed by a steel cage. A single winch drum provides both the pulling force and line storage.

General Data - Sepson Winch:

Line capacity: with 8 mm (5/16'') wire rope - 150 meters (500 ft.)

Line pull: 1500 kg. (3300 lbs.)

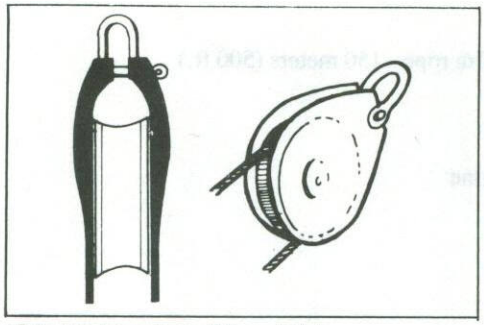
Power source: 14 hp. (10.5 kW) engine

Weight: 270 kg. (600 lbs.)

Manufacturer: Sepson
780 50
Vansbro, Sweden

GLOSSARY

Block - a heavy metal bracket containing a sheave which changes the direction of a wire rope



(Courtesy James Jones & Sons, Ltd.)

Bucker - a person responsible for cutting trees into shorter lengths, usually on the landing

Chaser - a person responsible for unhooking turns of logs at the landing and for removing any remaining stubs and limbs

Choker - the cable or chain fastened around logs being yarded

Chokerman - (choker setter) one who hooks the turns of logs in the forest for yarding to the landing

Chopper - a person responsible for felling trees

Decking - the piling of logs at the landing by the yarding machine

Deflection - see Line Deflection

Fairlead - a set of rollers or sheaves which guide a wire rope onto a winch drum

Gravity outhaul - the use of gravity in uphill logging to return an empty skyline carriage to the woods

Haul-back - the wire rope which pulls the haul-in line with a carriage or chokers back to the woods

Haul-in - the wire rope which pulls in a turn of logs

Landing - an area, usually near a road, where turns of logs are deposited at the end of each yarding cycle

Lateral Yarding - yarding of logs or thinnings from either side of a logging corridor

Lifting line - the cable which laterally yards and lifts turns of logs to a skyline carriage

Line deflection - the sag of a wire rope when stretched over an unsupported span

Logging corridor - the path along which turns of logs are yarded to the landing

Mainline - the haul-in line

Multi-span skyline carriage - a skyline carriage capable of passing over intermediate skyline supports

Setting - the area harvested from one location of a yarder

Sheave - a grooved wheel which changes the direction of a wire rope or supports a weight traveling along a wire rope

Single-span skyline carriage - a skyline carriage which can not pass over an intermediate skyline support

Skyline - the wire rope which serves as a track and support for a carriage

Strawline - a light wire rope or fiber rope used to pull out the heavier operating cables

Tail tree - a tree at the opposite end of a logging corridor from a yarder which supports and anchors a skyline

Turn - the load or hitch of logs transported from the woods to the landing with each cycle of the yarding system

Wire rope - (cable) strands of small wire wound together in a variety of arrangements to form a flexible steel rope many times stronger and wear resistant than fiber ropes

Yarding - the initial movement of timber from the stump to the landing

Yarding road - the entire area yarded from a logging corridor

TABLES

METRIC/ENGLISH EQUIVALENTS of MEASURES

Linear Measure:

1 millimeter (mm) ..... .0.03937 inch (")
1 meter (m) ..... .39.37 inches (")

1 inch (") ..... .25.4 millimeters (mm)
1 foot (ft.) ..... .0.3048 meter (m)

Area Measure:

1 hectare (ha.) ..... .2.471 acres (A.)
1 acre (A.) ..... .0.404 hectare (ha.)

Weight:

1 kilogram (kg.) ..... .2.204622 pounds (lbs.)
1 metric ton
1000 kilograms ..... .2204.6 pounds (lbs.)

1 pound (lb.) ..... .0.4536 kilogram (kg.)

Timber Volume:

1 cubic meter (m3)* ..... .220 board feet (bd. ft.)
Scribner Rule
35.3 ubic feet (ft. 3)*
0.4 rd (cd.)

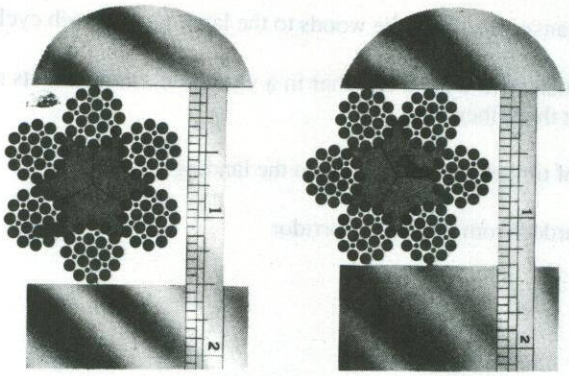
1 cord (cd.) ..... .2.4 cubic meters (m3)*

*solid wood volume

Power:

1 horsepower (hp.) ..... .0.746 kilowatt (kW)
1 kilowatt (kW) ..... .1.34 horsepower (hp.)

MEASURING WIRE ROPE



RIGHT WAY

Always measure the *larger* dimension, between the outer limits of the strands.

WRONG WAY

Do not measure the *smaller* dimension across the "flats" of the strands.

(Courtesy Bethlehem Steel Corp.)

WIRE ROPE WEIGHTS and STRENGTHS

Technical data for high grade wire ropes in the 6×19 Class.

Wire Rope Diameter		*Weight*		*Breaking Strengths*	
in.	*mm.*	*lbs/ft*	*kg/meter*	*pounds*	*kilograms*
¼	6.3	0.116	0.173	6,800	3,090
5/16	7.9	0.180	0.268	10,540	4,790
⅜	9.5	0,260	0.387	15,100	6,860
7/16	11.1	0.35	0.52	20,400	9,270
½	12.7	0.46	0.68	26,600	12,090
9/16	14.3	0.59	0.88	33,600	15,270
⅝	15.9	0.72	1.07	41,200	18,730
¾	19.0	1.04	1.55	58,800	26,730
⅞	22.2	1.42	2.12	79,600	36,180
1	25.4	1.85	2.76	103,400	47,000

REFERENCES

Aulerich, D. Edward, "Smallwood Harvesting Research at Oregon State University", *Logger's Handbook,* Vol. XXXV, 1975.

Aulerich, D. Edward, K. Norman Johnson, and Henry Froelich, "Tractors or Skylines: What's best for thinning young-growth Douglas-fir?", *Forest Industries,* November 1974.

Binkley, Virgil W., *Planning Single Span Skylines,* Skyline Logging Symposium, Corvallis, Oregon, Oregon State University, 1969.

Blackman, Ted, "Research project yields small, maneuverable thinning yarder", *Forest Industries,* September 1978. PEEWEE YARDER

Blackman, Ted, "Small, trailer-mounted yarder used in thinning", *Forest Industries,* December 1977. HIGHLAND TRAILER ALP

Bryan, Richard W., "Skidder-mounted tower yards hardwoods in Virginia cable test", *Forest Industries,* October 1975. ECOLOGGER I

Burke, Doyle, "Running skylines reduce access road needs, minimize harvest site impact", *Forest Industries,* May 1975.

Cable Logging in Appalachia?, Northeastern Forest Experiment Station, Photo Story No. 28. CHUBALL & URUS CLASS III

"Canadians like the Jones Alp", *Skyline,* No. 1, June 1976. HIGHLAND TRAILER ALP

Case, A.B., and E.C. Salter, *An evaluation of the Vinjevinsjen K-1200 radio-controlled cablecrane,* Newfoundland Forest Research Centre, December 1976. VINJE K-1200

Church, Thomas W., "The Chuball, A Unique New Device for Selectively Logging Steep Slopes", *Northern Logger and Timber Processor,* August 1972. CHUBALL

Coast Logging: Highlead Versus Long-reach Alternatives, FERIC, Summary of Technical Report No. TR-19, December 1977.

Cottell, P.L., B.A. McMorland, and G.V. Wellburn, *Evaluation of Cable Logging Systems in Interior B.C. and Alberta,* FERIC Technical Report No. TR-8, September 1976. SKYLOK 78, ECOLOGGER I, SKAGIT GT-3

Dykstra, Dennis P., *Yarding Delays for Advanced Logging Systems,* Oregon State University Research Paper 33, October 1976.

Forbes, R.D., editor, *Forestry Handbook,* The Ronald Press Co., New York, 1955.

Gibson, Harry G., and Cleveland J. Biller, "A Second Look at Cable Logging in the Appalachians", *Journal of Forestry,* 73:10, October 1975. URUS CLASS III

Giordano, G., *Logging Cableways,* FAO, Geneva, Switzerland, 1959.

Gochenour, Donald L., Edward L. Fisher, and Cleveland J. Biller, "An analytical appraisal of cable logging technique in Appalachia", *Forest Industries,* October 1978. URUS CLASS III

Handley, D.L., *Mini-Skyline Thinning,* 1975. HIGHLAND TRAILER ALP

Hatch, R.P., *Multiple Drum, Mini-Skylines.* HIGHLAND TRAILER ALP

Herman, Francis R., *A test of Skyline Cable Logging on Steep Slopes,* Rocky Mountain Forest and Range Experiment Station, Paper No. 53, October 1960. WYSSEN

"Hi-Lead Attachment on Big Stick Loader", *American Pulpwood Association Technical Release,* No. 61-R 37, October 1961. BIG STICK

Host, John R., *Feasibility of Using an Inexpensive Cable Yarding System in Montana to Improve Timber Utilization.*

Host, John R., *Logging Systems for Small Timber - Cost Study*, INT - 3251 - 13.

Husak, N., *High Lead Yarding in Bundles*, 1951.

Jando, Tibor L., *The Tension Skidder Yarding System*. RUNNING SKYLINES

Joint Committee on Forest Working Techniques and Training of Forest Workers, *Symposium on forest operations in mountainous regions*, FAO, U.S.S.R., 1971.

Kellogg, Loren, and Edward Aulerich, "Prebunch-and-swing technique may reduce your thinning costs", *Forest Industries*, February 1977. RADIO-CONTROLLED PREBUNCHING WINCH

Letkeman, Rick, "Small volumes on steep hills, challenge for Triangle-Pacific", *Canadian Forest Industries*, November 1973.

Lisland Torstein, *Cable Logging in Norway*, Corvallis, Oregon, Oregon State University Dept. of Printing, 1975. VINJE K-1200, JOBU COMBI CAT, IGLAND ALP WINCH

Lysons, Hilton H., *Harvesting Thinnings on Steep Ground*, Pacific Northwest Forest and Range Experiment Station.

Lysons, Hilton H., "Running Skyline Yarding System Has Merit", *Western Conservation Journal*, January - February 1973.

Mason, Duane, "Mini yarder solves small log problems", *Logging Management*, February 1978. HIGHLAND TRAILER ALP

Matson, E.E., *The Wyssen Skyline System*, S.A.F. meeting proceedings, 1955. WYSSEN

Maxwell, H.G., and D. Oswald, "Cable Yarder Thinning Proves Successful in British Columbia", *Canadian Forest Industries*, September 1975. HIGHLAND TRAILER ALP

Maxwell, H.G., and D. Oswald, *European Cable Yarder Thinning Successfully in British Columbia*, Environment Canada - Forest Management Institute. HIGHLAND TRAILER ALP

"Mobile yarders tackle steep terrain, meet FS regulations", *Forest Industries*, April 1973. SKYLOK 78

Neilson, Dennis, *The Production Potential of the Igland-Jones Trailer Alp Yarder in Thinning Young Growth Northwest Conifers: A Case Study*, Oregon State University, December 1977. HIGHLAND TRAILER ALP

O'Leary, John, "A New Concept for Thinning on Steep Ground", *Managing Young Forests in the Douglas-Fir Region*, Vol. 4, July 1974. VINJE K-1200

Parker, E.G., "Cable Logging Systems", *Northern Logger and Timber Processor*, June 1976. SKYLOK 78

Perkins, Robert H., "The Purdue Traction-Cable Running Skyline System", *Journal of Forestry*, 73:8, August 1975.

Perkins, Robert H., "A Size-Engineered Running Skyline System: An Environmentally Sound Approach to Logging in Appalachian-Type Terrain", *Forest Products Journal*, 23:11, November 1973. PURDUE RUNNING SKYLINE

Peters, Penn A., *Estimating Production of a Skyline Yarding System*, Logging Symposium, Oregon State University, Corvallis Oregon, December 1973.

Peters, Penn A., and D. Edward Aulerich, *Timber Harvest Using an Intermediate Support System*, ASAE Paper No. 77-1564, December 1977.

Putnam, M.M., *Lawrence Winch for Skidding and Loading*, Canadian Pulp and Paper Association, June 1945.

Sessions, John, "Logging Techniques in the Mountains of Jamaica", *Unasylva*, 26:105.

Shaw, Charles L., "Pint-size tower testing out well in thinning Coastal fir stands", *Forest Industries*, 101:12, November 1974. HIGHLAND TRAILER ALP

Skory, Larry D., and Warren Strong, "Newfoundland's inaccessible wood supply now closer to economical harvest", *Canadian Pulp and Paper Industry*, February 21, 1978. ECOLOGGER I

Sommer, Herman C., *Cable Thinning Systems*.

Studier, Donald D., and Virgil W. Binkley, *Cable Logging Systems*, Oregon State University, Corvallis, Oregon, 1974.

Tateishi, M., *High Lead Yarding in Tree Lengths*, 1951.

Taylor, Harvey, A. Boyde Case, Warren Strong, *Joint Report on Cable Logging in Scotland and its Application in Newfoundland*, 1977. TIMBERMASTER & HIGHLAND TRAILER ALP

"Tinker Toy has Muscle MB Foresters Find", *Hiballer*, October 1974. HIGHLAND TRAILER ALP

Trzesniowski, A., Logging in the Mountains of Central Europe, FAO, Rome, 1976.

Waelti, Hans, "Long Reach Skylines", *Skyline Logging Symposium*. WYSSEN

Wellburn, G.V., "Cable Logging is Effective but too Costly", *Pulp and Paper Canada*, 77:10, October 1976.

Wendel, G.W., and J.N. Kochenderfer, "Damage to Residual Hardwood Stands Causd by Cable Yarding with a Standing Skyline", *Southern Journal of Applied Forestry*, November 1978.

Wendel, George W., James N. Kochenderfer, and Cleveland J. Biller, "Skyline Cable Logging in West Virginia", *Northern Logger and Timber Processor*, June 1974.

"WESTVACO Weds Yarders to Whole Tree Chippers", *Pulpwood Production and Saw Mill Logging*, December 1973. SKYLOK 78

Return copy to:

Gerry Hawkes

798 Wayside Road Ext.
Woodstock, VT 05091

866-63-TREES (W) ~ 802-457-2669 (H)

Eco Systems, Inc. ~ www.eco-systems.org ~ President
Forest Savers, LLC ~ www.forest-savers.com ~ Manager
Bike Track, Inc. ~ www.biketrack.com ~ Founder / Director
Woodland Balance ~ domestic / international consulting

802-356-3215 (C) ~ ghawkes@wildblue.net ~ 802-457-2483 (F)