

# CARRIAGES FOR SKYLINES

*by*

**Donald Studier**



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### **The Author**

Donald Studier is instructor (courtesy), Department of Forest Engineering, College of Forestry, Oregon State University, Corvallis, Oregon, and also logging engineer, USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

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# Abstract

Carriages may be classified as slackpulling or non-slackpulling, and the slackpulling carriages may be further classified by how they accomplish the slackpulling function. Slackpulling carriages provide the skyline with lateral yarding capability and therefore can be used in a variety of silvicultural prescriptions. Non-slackpulling carriages can include either chokers or grapples and are used in clearcuts. For a skyline system to operate efficiently, the carriage must be matched to the number of lines and the line diameters on the yarder.

# Introduction

A carriage used in skyline logging is a wheeled device that rides back and forth on the skyline and from which logs are suspended (Mifflin and Lysons 1979). Carriages are used on standing, live, and running skylines. An example of a skyline system is shown in Figure 1. For the system to operate efficiently, the carriage must be matched to the yarder. Three basic requirements must be met:

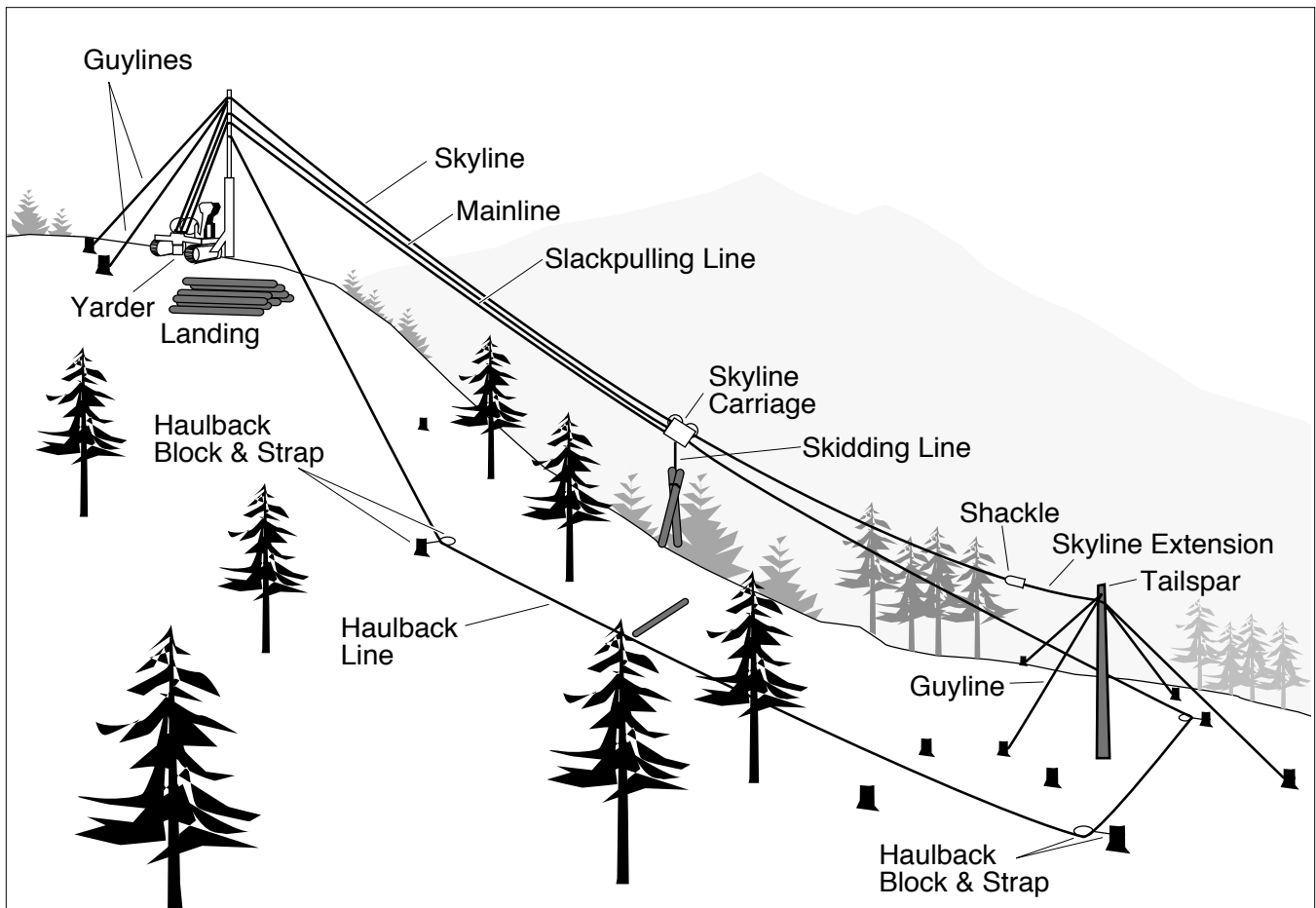


Figure 1. Skyline system with slackpulling carriage.

- (a) The skyline sheaves in the carriage must be matched to the skyline diameter. The groove in most sheaves will accept only a narrow range of skyline diameters—for example, 3/4 to 1 inch. On many carriages it is relatively easy to replace existing skyline sheaves with sheaves of the proper size, but other carriages will accept only one size of sheave.
- (b) The yarder must have enough drums to operate the carriage. Some carriages may require up to four drums.
- (c) Mainline size must be appropriate. This is very important on slackpulling carriages where the mainline passes through the carriage and becomes the skidding line, or where it is wrapped on a drum in the carriage, because the sheaves and drum are sized to a particular line size. Changing that size may cause unnecessary line wear, damage the sheaves, or lead to loads that exceed the carriage’s design load.

There are two categories of carriages—slackpulling and non-slackpulling (Studier and Binkley 1975). Figure 2 classifies and lists some examples of currently used carriages. In slackpulling carriages, a line payed out from the carriage can be pulled to the side of the skyline and attached to the logs, thus increasing the skyline’s lateral yarding capability. This line is referred to as a skidding line, tong line, or drop line. The skidding line may be a separate line contained on a drum in the carriage, it may be attached to the mainline from the yarder, or it may be an extension of the mainline.

Non-slackpulling carriages, which have either chokers or grapples attached directly to the carriage, are limited in lateral capability to the length of the choker, or to logs directly under the grapple.

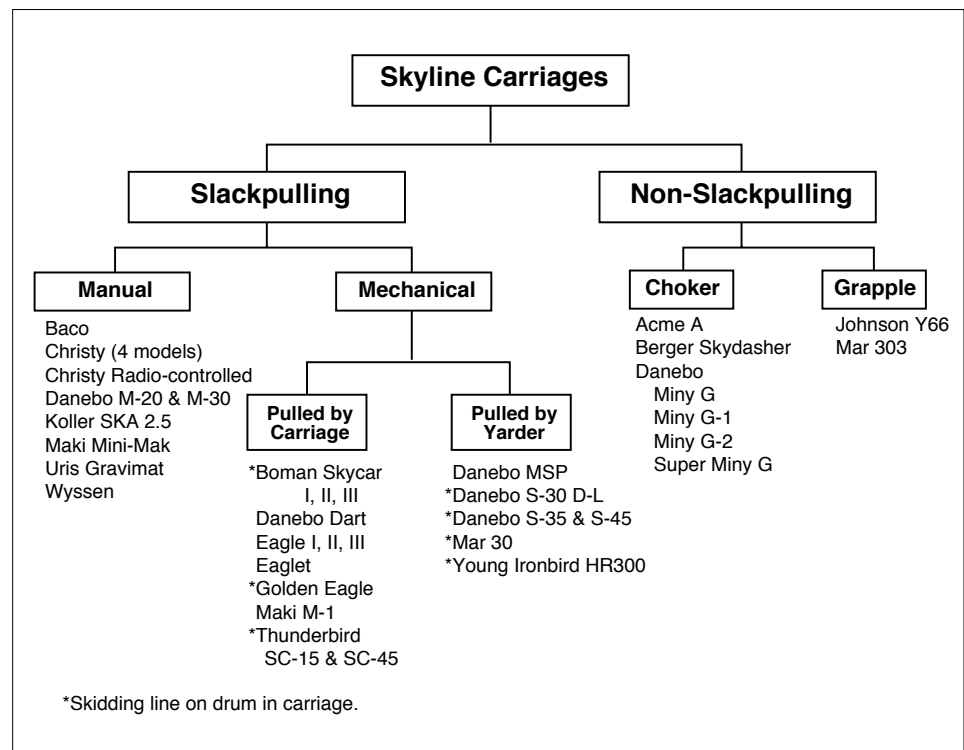


Figure 2. Categorization of currently used skyline carriages.

# Slackpulling Carriages

Slackpulling carriages can be used in any type of silvicultural prescription, and they are especially useful for yarding logs in stands where the residual trees need to be protected from yarding damage. In clearcuts, they reduce the amount of rigging needed by extending the width of the skyline roads. Slackpulling carriages may be further classified by how they accomplish the slackpulling function. In manual slackpulling carriages, the mainline or skidding line must be pulled through the carriage by hand, whereas mechanical slackpulling carriages use some type of power source to pay out the skidding line. The power source may be in the carriage or on the yarder.

## Manual

All slackpulling carriages must maintain a fixed position on the skyline during the lateral yarding operation. The manual slackpulling carriages, which are used on either live or standing skylines (Table 1), may use: (a) a haulback line to hold the carriage in place; (b) a hydraulic or mechani-

Table 1.<sup>1</sup> Slackpulling carriages: Manual

Carriage	Model	Maximum	Clamps during		Yard.	System <sup>3</sup>	Remarks
		Weight (lbs)	skyline size (inches)	lateral yarding			
Baco		10,000	1 1/2	Mechanical clamp	D	S	Carriage cycles <sup>4</sup>
Christy	Small	160	5/8	Stop on skyline	U	L	
Christy	Regular	340	7/8	Stop on skyline	U	L	
Christy	Heavy Duty	450	1 1/8	Stop on skyline	U	L	
Christy	Large	1,500	1 3/8	Stop on skyline	U	L	
Christy	Radio-cont.	1,000	1 1/8	Radio-controlled	U	L	
Danebo	M-20	1,460	7/8	Manually	U	L	
Danebo	M-30	2,250	1 3/8	Manually	U	L	
Koller	SKA 2.5	550	1 1/8	Mechanical clamp	U	S	Carriage cycles
Maki	Mini-Mak	600	1	Stop on skyline	U	L	
Ross		900	1 1/8	Manually	U	L	
Skagit	Wheel	275	1 1/8	Stop on skyline	U	L	
Uris	Gravimat	680	1	Mechanical clamp	U	S	Carriage cycles
Western Flyer	BB	1,200	3/4	Manually	U	L	
Western Flyer	DG	1,800	1 1/8	Manually	U	L	
Western Flyer	HW	1,500	7/8	Manually	U	L	
Wyssen	W-90	878	1 1/4	Hydraulic clamp	D	S	Carriage cycles
Wyssen	W-200	3,000	1 3/8	Hydraulic clamp	D	S	Carriage cycles-

<sup>1</sup> Tables may include models no longer in use.

<sup>2</sup> U = uphill, D = downhill

<sup>3</sup> S = standing, L = live

<sup>4</sup> To activate the clamp, carriage must either 1) be motionless for a period of time to allow hydraulic pressure to

cal device in the carriage that clamps it to the skyline (Figure 3); or (c) a separate stopping device clamped to the skyline to which the carriage can lock (Figure 4). After the carriage is secured in position, the skidding line, which is actually an extension of the mainline, is manually pulled to the logs through the carriage, which acts as a block. Because the mainline has to be stripped from its drum on the yarder during the slackpulling operation, a hydraulic device called a slack-kicker may be installed on the yarder to aid in pulling the line from the drum.

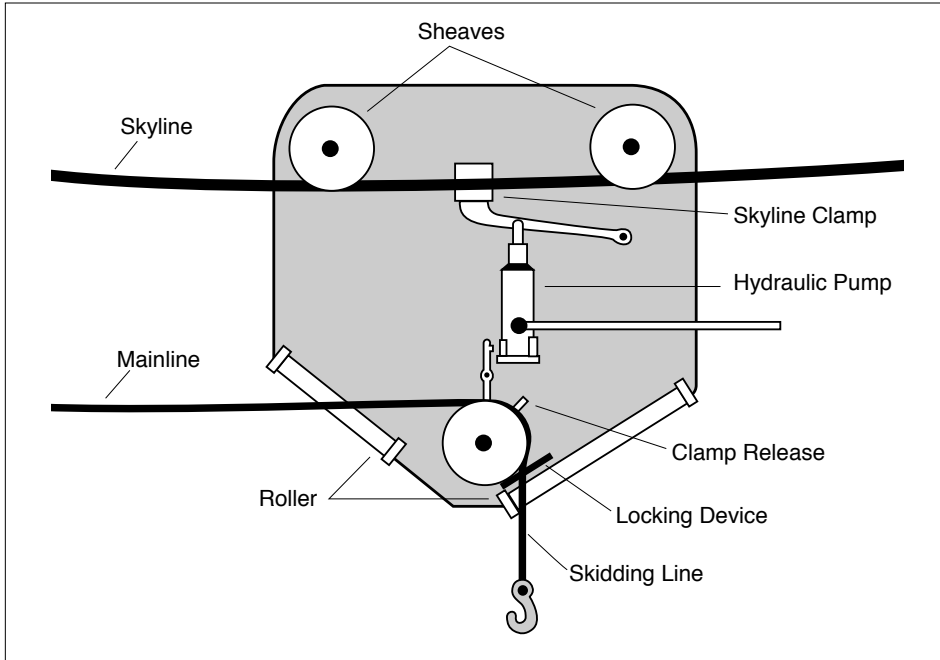


Figure 3. Manual slackpulling carriage with skyline clamp.

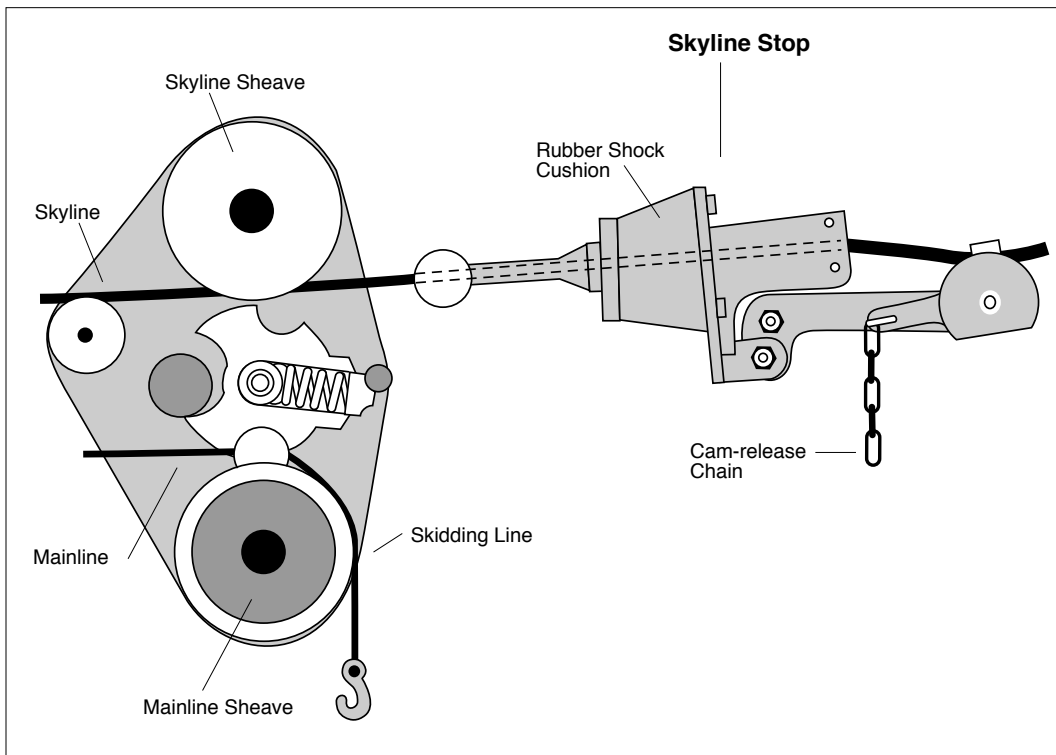


Figure 4. Manual slackpulling carriage with skyline stop.



Most manual slackpulling carriages have a device inside the carriage that holds the logs directly beneath the carriage; thus, if the mainline goes slack, the logs will not drop. Manual slackpulling carriages can be operated on a two-drum yarder if the mainline and skyline sizes are correct. If logs are to be picked up on the opposite slope, or if yarding is downhill, a haulback line is required. However, either of these situations involves manually pulling slack uphill. In thinnings, some operators prefer to use a haulback even for uphill yarding so they can get free of hangups more easily by repositioning the carriage.

If the yarding distance is to be extended by adding skyline with a shackle (see Figure 1), the carriage should be checked to see whether it can pass over it. Most of the manual slackpulling carriages that clamp will not pass over a shackle. A skyline extension may be spliced rather than shackled, allowing use of a wider selection of carriages.

## Mechanical

Mechanical slackpulling carriages use a power source to pay out the skidding line from the carriage. The power source may be located in the carriage or at the yarder.

### Pulled by carriage

Power sources for carriage-powered carriages (Table 2) have included diesel engines, propane engines, hydraulic motors, and springs. No matter what type of power is used, these carriages operate in one of two ways: (a) the skidding line is an extension of the mainline and the power source pays out the line, but the yarder pulls it in once it is attached to the logs (Figure 5); or (b) the skidding line is contained on a drum in the carriage and the power source both pays out the line and winches it in (Figure 6).

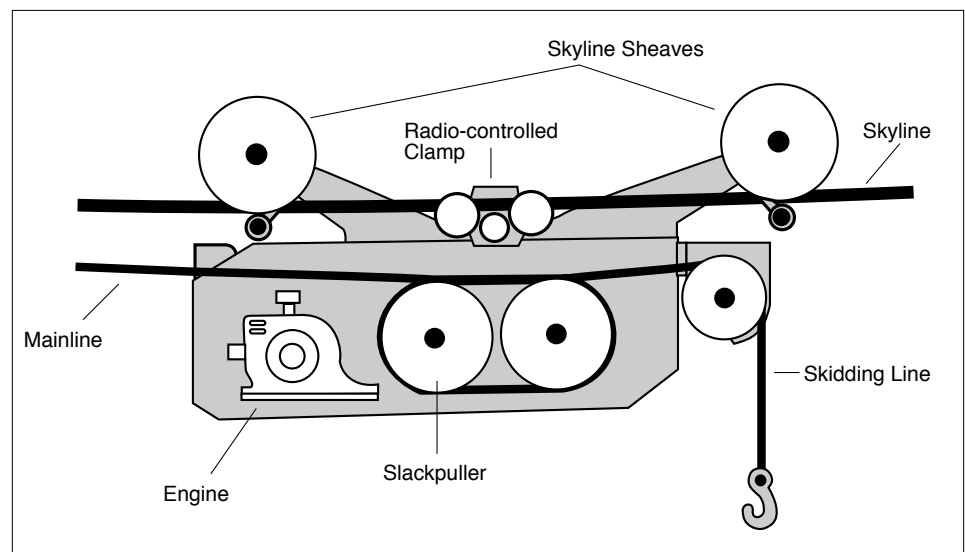


Figure 5. Mechanical slackpulling carriage with skidding line an extension of the mainline. Power source for pulling slack in carriage.

Table 2. Mechanical slackpulling carriages: Slackpulled by carriage<sup>1</sup>——

Carriage	Model	Weight (lbs)	Maximum skyline size (inches)	Yard. direc. <sup>2</sup>	Line capacity of self-contained skidding drum (ft) <sup>3</sup>	Remarks
Berger	Skyhawk	3,800	1 3/8	U, D	325' of 3/4"	
Boman	Sky Car I	9,000	1 3/4	U, D	400' of 3/4"	
Boman	Sky Car II	7,100	1 1/2	U, D	400' of 3/4"	
Boman	Sky Car III	6,600	1 1/4	U, D	400' of 3/4"	
Danebo	Dart	3,100	1 1/4	U	—	
Danebo	M 110	3,800	1 1/2	U	—	Spring-activated slackpuller
Danebo	SC-40	6,800	1 7/8	U, D	380' of 3/4"	
Eagle	I	4,800	1 1/2	U	—	
Eagle	II	2,600	1 1/8	U	—	
Eagle	III	3,600	1 1/4	U	—	
Eagle	Eaglet	1,200	7/8	U	—	
Eagle	Golden Eagle	8,000	1 1/2	U, D	500' of 5/8"	
Maki	M-1	2,150	1 1/8	U	—	
Maki	II	1,250	1	U	—	
RMS	Skyhawk	2,800	2	U	—	Hydraulic motor pulls slack
Skagit	RCC 10	3,000	1 1/8	U	—	Propane engine
Skagit	RCC 13	3,200	1 1/2	U	—	Propane engine
Skagit	RCC 15	6,900	1 1/2	U, D	440' of 7/8"	
Skagit	RCC 20	9,000	2	U, D	500' of 7/8"	
Thunderbird	SC-15	4,200	1 1/8+	U, D	370' of 5/8"	
Thunderbird	SC-45	6,400	1 3/8+	U, D	425' of 3/4"——	

<sup>1</sup> Recommended for standing skylines

<sup>2</sup> U = uphill, D = downhill

<sup>3</sup> All carriages without a self-contained skidding drum have a radio-controlled hydraulic skyline clamp.

Both types of carriages are usually equipped with a clamp to hold them in place during lateral yarding.

On most of these carriages, the skyline sheaves are mounted on top of the carriage and can be changed to match the skyline diameter. A two-drum yarder with skyline and mainline is sufficient unless yarding is from the opposite slope or downhill, in which case a drum for the haulback line may be needed as well. If the carriage has a self-contained skidding drum, the mainline size has little effect on the carriage operation. If the mainline passes through the carriage and becomes the skidding line, however, the line size must be matched to the slackpulling device in the carriage.

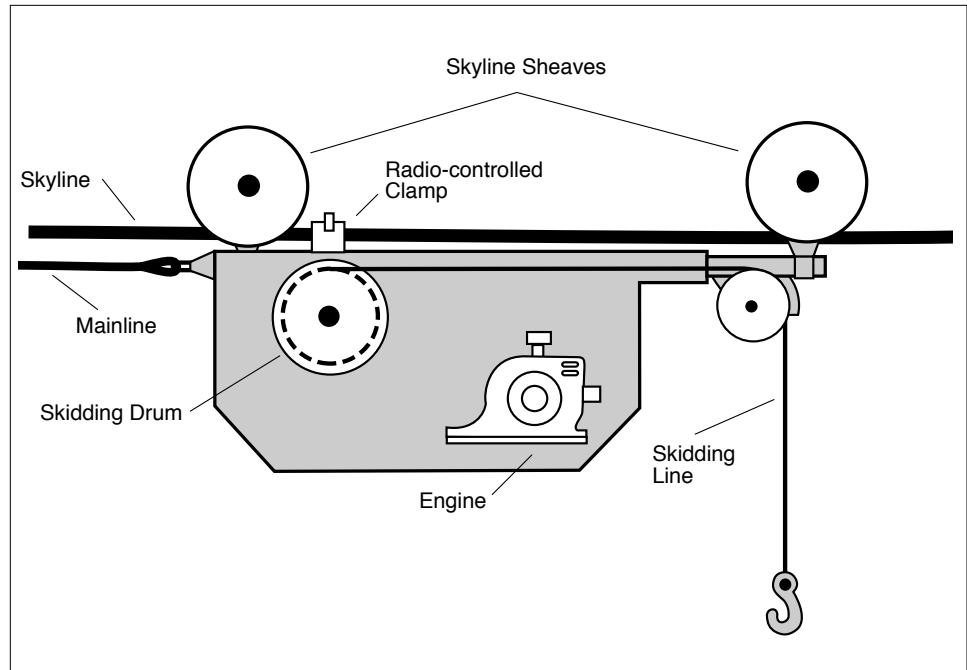


Figure 6. Mechanical slackpulling carriage with self-contained skidding line. Power source for pulling slack and yarding logs in carriage.

### **Pulled by yarder**

Mechanical slackpulling carriages powered from the yarder (Table 3) are much less complicated than those with a self-contained power source. The carriage usually weighs less and therefore provides a more usable payload; thus electronics to control its operation may not be needed. When the power source is removed from the carriage, however, an additional drum is needed on the yarder for pulling slack in the skidding line.

There are two basic types of yarder-controlled mechanical slackpulling carriages. Both require skyline, mainline, slackpulling line, and haulback line for operation. In one type, including the Danebo MSP, the skidding line is attached to the mainline, which is pulled through the carriage by a slackpulling line (Figure 7). To ensure that the skidding line pays out when the slackpulling line is pulled, a pressure roller bears on the skidding line where it passes over the sheave in the carriage.

The other type of yarder-controlled carriage contains the skidding line on a drum in the carriage (Figure 8), with drums for the mainline and slackpulling line on the same shaft; thus the carriage weight is increased. Because the mainline is wound over and the slackpulling line under, the skidding line can be pulled in by the mainline or out by the slackpulling line. Carriages in this category use a haulback line to hold them in position during lateral yarding, or they may have a clamp actuated by hydraulics or springs.

Some carriages were developed to be used with fewer lines from the yarder. One example is the Young Ironbird HR300 (Figure 9), which has

a radio-controlled hydraulic clamp and needs only skyline, mainline, and haulback line. The haulback line is used to pull slack from the skidding drum and thus eliminates the need for a slackpulling line. Two European companies, Wyssen and Baco, developed endless-line systems in which the carriage operates on a standing skyline and the haulback line and mainline are combined to operate as one endless line.

Table 3. Mechanical slackpulling carriages: Slackpulled by yarder

Carriage	Model	Weight (lbs)	Maximum skyline size (inches)	Line capacity of self-contained skidding drum	Yard. direc. <sup>1</sup>	System <sup>2</sup>	Remarks____
Baco (endless line)		3,000	1 1/2	–	U, D	S	Carriage cycles and clamps to skyline
Berger	C-1	570	1 1/8	–	U, D	S	
Berger	C-2	825	1 3/8	–	U, D	S	
Berger	C-3	850	7/8	–	U, D	R	
Berger	C-4	1,300	1 1/2	–	U, D	S	
Berger	C-6	3,000	1 3/8	–	U	S	
Berger	Skyscamper	590	1	–	U, D	S	
Danebo	MSP	600	1	–	U, D	S, L, R	
Danebo	S-30	1,825	3/4	175' of 3/4"	U, D	S, L, R	
Danebo	S-30 D-L	2,200	1	175' of 3/4"	U, D	R	
Danebo	S-35	1,600	7/8	250' of 3/4"	U, D	S, L, R	
Danebo	S-40	2,100	7/8	275' of 7/8"	U, D	S, L, R	
Danebo	S-45	3,100	1 3/8	300' of 1"	U, D	S, L, R	
Danebo	S-50	5,200	1	300' of 1"	U	S, L, R	
Interstate	I-DLC-36	1,600	1 1/8	250' of 3/4"	U, D	S, L, R	
Madill	052	3,800	1 1/8	450' of 7/8"	U, D	R	
Mar	30	1,000	7/8	135' of 3/4"	U, D	S, L, R	
Pape	Shuttle Bug	1,300	7/8	200' of 5/8"	U, D	S, L, R	
West Coast		2,000	1 1/8	235' of 3/4"	U, D	S, L, R	
Wyssen	Unimat	1,000	1 1/4	–	U, D	S	Uses endless mainline
Young	Ironbird HR300	3,500	1 1/2	300' of 7/8"	U, D	S, L	Radio-controlled hydraulic clamp
Young	YCC-13	450	3/4	–	U, D	R	

<sup>1</sup> U = uphill, D = downhill

<sup>2</sup> S = standing, L = live, R = running

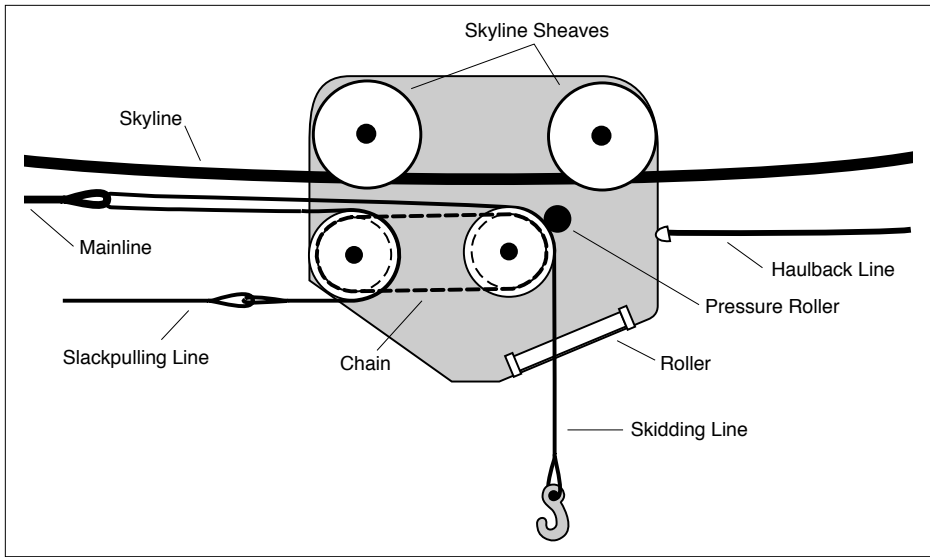


Figure 7. Yarder-controlled mechanical slackpulling carriage with skidding line attached to mainline.

Figure 8. Yarder-controlled mechanical slackpulling carriage with self-contained skidding line.

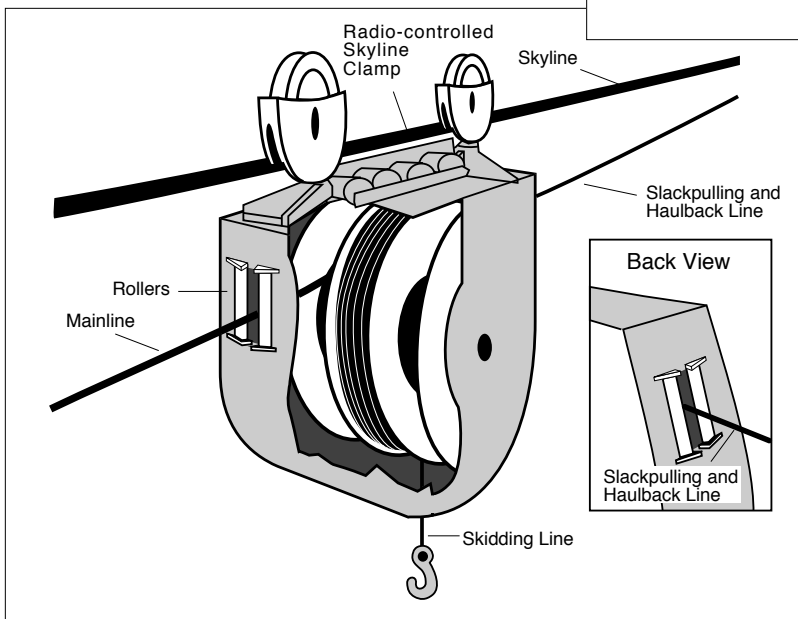
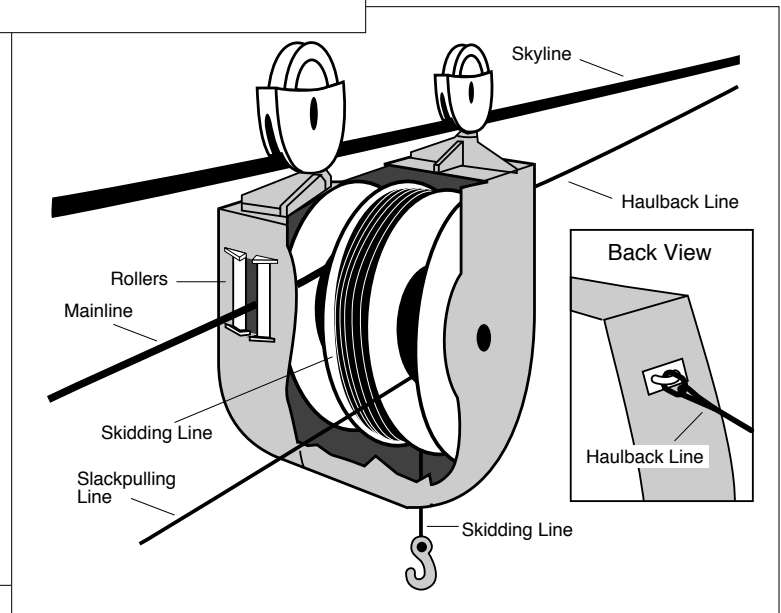


Figure 9. Young Ironbird HR300 mechanical slackpulling carriage on three-drum yarder.

# Non-slackpulling Carriages

A carriage that provides no lateral yarding capability is referred to as a non-slackpulling carriage. It may have chokers attached directly to the bottom of the carriage, or it may be a grapple carriage. Non-slackpulling carriages are not suited for use in partial cuts or thinnings. A two-drum yarder with a live skyline and a mainline is sufficient for operating these carriages unless a haulback line is needed for downhill yarding.

## Carriages with Chokers

Carriages with chokers are commonly referred to as shotgun or flier carriages (Table 4, Figure 10). They have no lateral yarding capability beyond the length of the chokers, which are attached to the bottom of the carriage.

Some choker carriages may have a radio-controlled hydraulic clamp that will hold the carriage in place on the skyline; they are thus useful for yarding logs from the slope opposite the landing. Once the clamp is released, however, the carriage may run back toward the yarder, creating slack in the mainline.

Table 4. Non-slackpulling carriages: Choker<sup>1</sup>—

Carriage	Model	Weight (lbs)	Maximum skyline size (inches)	Remarks
Acme	A	3,100	—	
Acme	B	3,000	—	
Berger	C-5	2,870	1 3/8	
Berger	Skydasher	2,600	1 3/4	
Danebo	B-1	5,200	1 5/8	Radio-controlled hydraulic clamp
Danebo	B-2	3,500	1 1/4	Radio-controlled hydraulic clamp
Danebo	Miny G	2,900	1 1/4	
Danebo	Miny G-1	4,200	1 5/8	
Danebo	Miny G-2	1,600	1 1/8	
Danebo	Super Miny G	900	1	
Forester	86	1,800	1	
Forester	100	2,400	1 3/8	
Skagit	Sky Skooter	3,300	1 3/8	
Skookum	GO-16W	3,000	1 3/8	
Skookum	GO-18	2,750	1 3/8	
Young	75A	3,600	1 5/8	Radio-controlled hydraulic clamp—

<sup>1</sup> Used on live skyline, for uphill yarding.

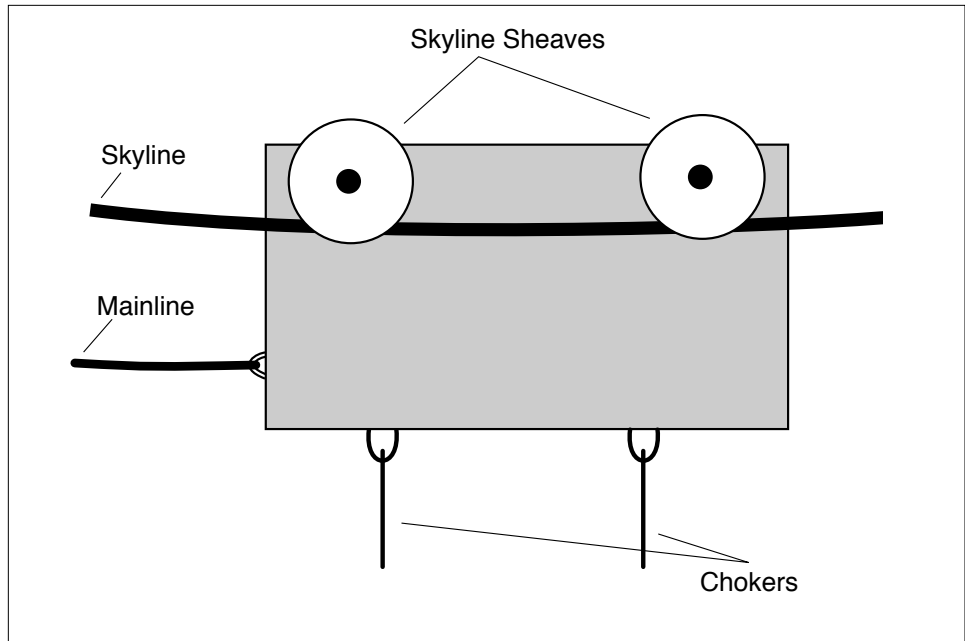


Figure 10. Flyer or shotgun carriage—non-slackpulling.

## Grapple Carriages

Grapple carriages can only pick up logs that are directly under the carriage and within reach of the grapple jaws (Table 5). The design of the grapple carriage (Figure 11) is similar to that of some of the mechanical slackpulling carriages. The primary difference is that the skidding line is replaced by a grapple, which eliminates lateral yarding capability.

Table 5. Non-slackpulling carriages: Grapple—

Carriage	Model	Weight (lbs)	Maximum skyline size (inches)	Haul- back req'd?	System <sup>1</sup>	Remarks—
Johnson	Y66	1,550	1	Yes	R	Power-closing
Johnson	Y84	2,400	1 1/4	Yes	R	Power-closing
Mar	303	1,700	1	Yes	R	Power-opening
Mar	803	2,000	1 3/8	Yes	R	Power-opening
Skagit	Grapple	1,200	1	Yes	L, R	Power-opening
Skagit	RCC-24	9,000	1 1/2	No	L	Power-opening
Snapper		5,000	1 1/2	No	L	Radio-controlled; grapple rotates
Washington	Shriver	4,200	1 1/2	No	L, R	Power-opening
Young	YD-60	1,550	7/8	Yes	R	Power-closing
Young	YG-80	1,950	1	Yes	R	Power-closing—

<sup>1</sup> L = live, R = running

A line from a power device in the carriage or from the yarder is used to open or to close the grapple. Power-opening grapples use the power source to open the grapples, and the weight of the grapple jaws causes them to close. Power-closing grapples work in the opposite way. The power-opening grapples are more commonly used in yarding operations with large logs, and the power-closing grapples are used in loading operations or when bunches of small logs are yarded. It is common to attach a choker to the grapple carriage (Figure 11) to yard logs that are not within reach of the grapple.

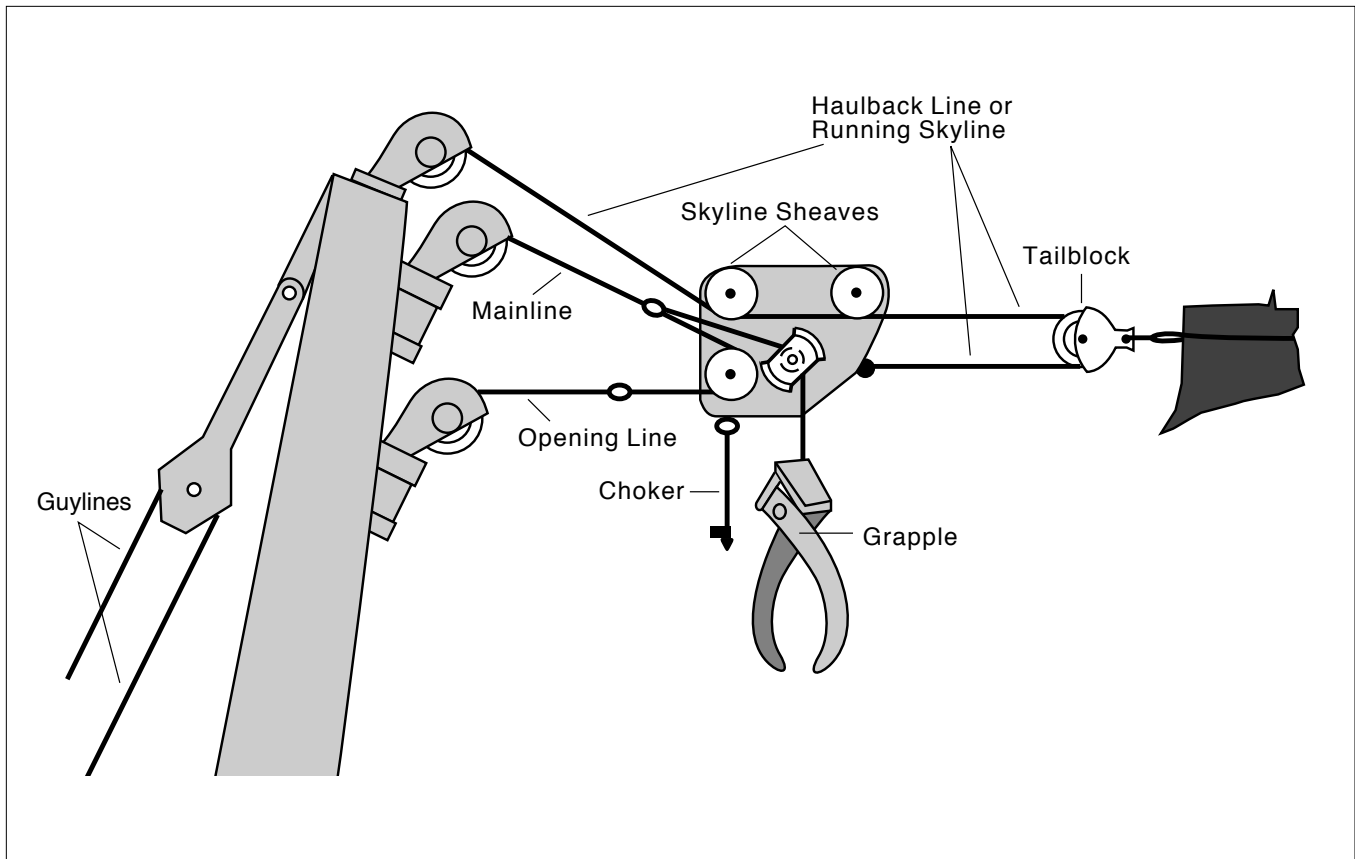


Figure 11. Running skyline grapple carriage—non-slackpulling.

## Multi-span Skylines

A carriage must be able to pass an intermediate support jack if it is to be used on a multi-span system. To pass intermediate support jacks, the carriage must have open-sided sheaves (Figure 12). Some carriages can be modified to have such sheaves. Others may be hung below a specially designed “truck” that will pass over the jack. In addition, skyline clamps must not interfere with passage over the jack.



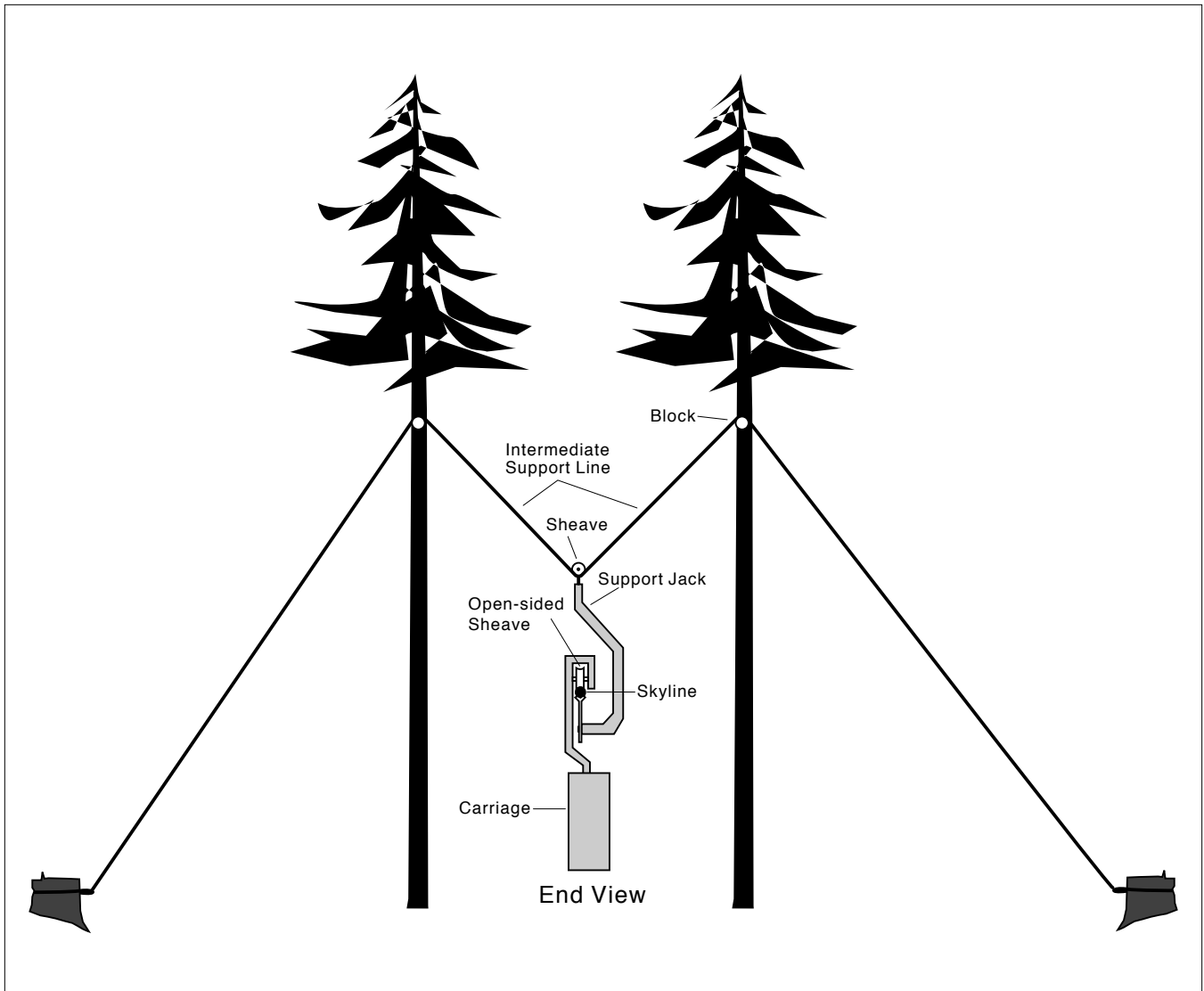


Figure 12. Intermediate support jack.

## Summary

Skyline systems use a carriage to aid in yarding logs to the landing. A slackpulling carriage may be used with any type of silvicultural cutting prescription, but non-slackpulling carriages can only be used in clearcuts. For a carriage to be compatible with the skyline system, its skyline sheaves and slackpulling mechanism must be sized correctly to accommodate the line sizes on the yarder. Some carriages require a slackpulling line and a haulback line in addition to the skyline and mainline for operation. For a complete description of how the various carriages operate, consult literature from the equipment companies.

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**Studier, Donald. 1993. CARRIAGES FOR SKYLINES. Forest Research Laboratory, Oregon State University, Corvallis. Research Contribution 3. 14 p.**

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