Single Rope Technique

Text and illustrations by Joe Harris, except where © SherrillTree, then used with permission of SherrillTree

Technical advice and many corrections by Scott Sharpe and Grant Cody

victorian tree industry organisation

CONTENTS

INTRODUCTION

Single Rope Technique (SRT) is fast becoming recognised as one of the safest and most efficient methods of accessing tall trees. This document aims to describe some of the basics of setting up and using an SRT system, and highlights some of the important potential risks when using these techniques.

To begin with, an access line is set in a suitable fork high in the tree. The way in which you set your line, and the manner in which it is tied off, have a large impact on the force you are generating on the tree. A brief run through of these concepts are covered in the **setup** section.

Tom Greenwood using SRT to access a fire-damaged *E. cypellocarpa*

The climber then attaches himself or herself to the rope using one of a number of different SRT systems. There are an enormous variety of systems out there, and this document aims to describe only a small handful, which you will find in the **systems** section.

Once at the desired height the climber may decide to work directly from the access line or change over to a conventional double rope tree climbing technique. Some more options for the use of the access line are given in the **working with SRT** section. The secure side of the access line may also be used to descend out of the tree using a suitable descending device. It is not normally considered acceptable to conduct any cutting work whilst still on an SRT system.

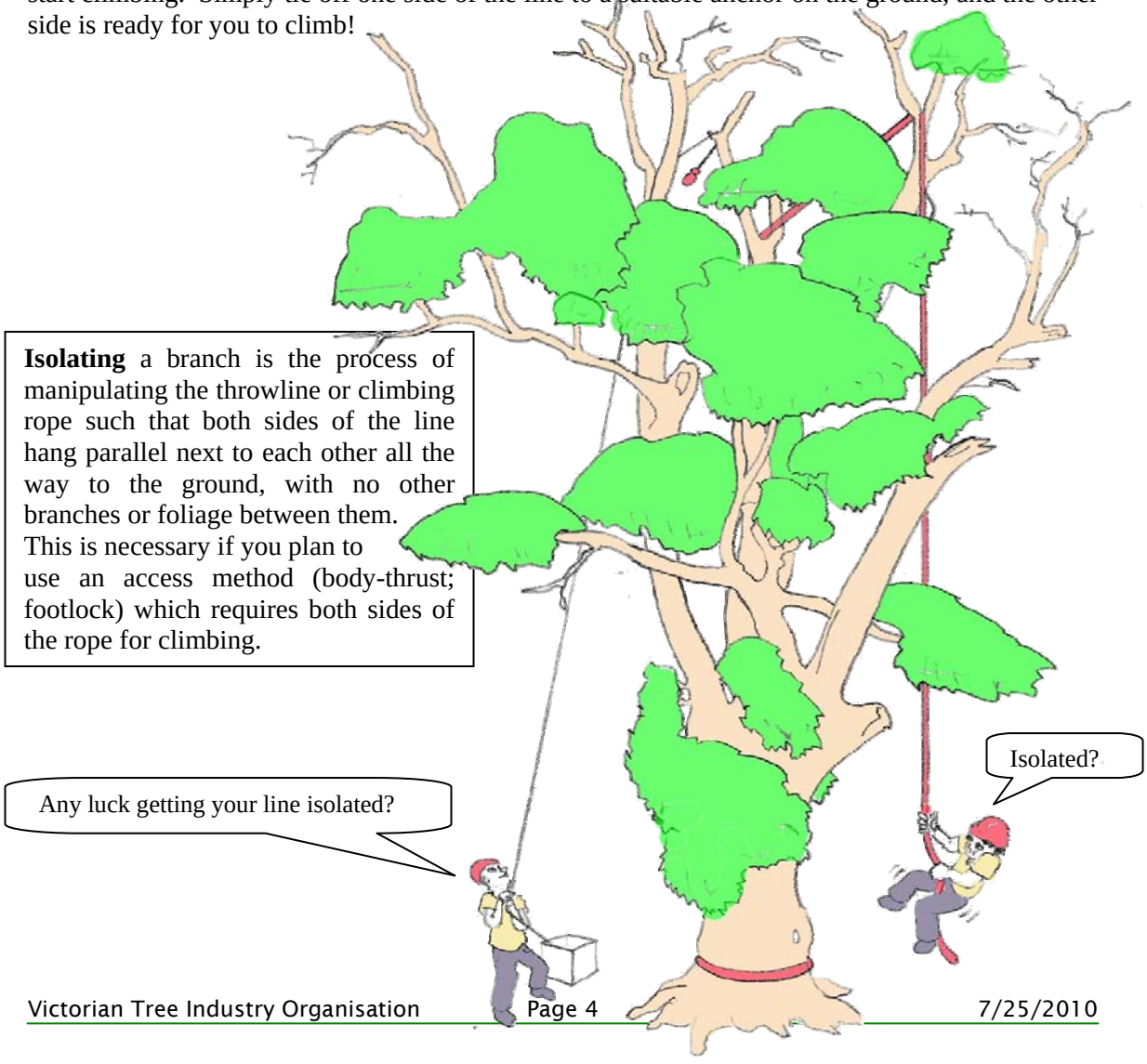
1 SETUP

Most SRT setups begin with the installation of a line through a fork (or forks) high in the tree. In general this is done with a throwline or Big Shot; in taller trees (65m or more) it may be necessary to use a compound bow, crossbow or other line-firing device.

The suitable fork should be healthy, have no signs of decay, be no less than 100mm in diameter and preferably be close to a main trunk of the tree. The access line is then tied off in a manner such that one side is suitable for climbing. **The access line is normally left in the tree whilst the climber is aloft thus giving direct access to the tree should the climber require assistance at any time throughout the climb.**

The great strength of SRT, and a way in which it is a time-efficient technique for tree access even in smaller trees, is that **you do not necessarily need to isolate the target fork**. Although climbers familiar with SRT may find it obvious, it is worth highlighting as it means that SRT becomes a very good option even in small trees where there is a lot of internal growth. So long as you have thrown over a sound fork, the two sides of your line do not need to be parallel for you to start climbing. Simply tie off one side of the line to a suitable anchor on the ground, and the other side is ready for you to climb!

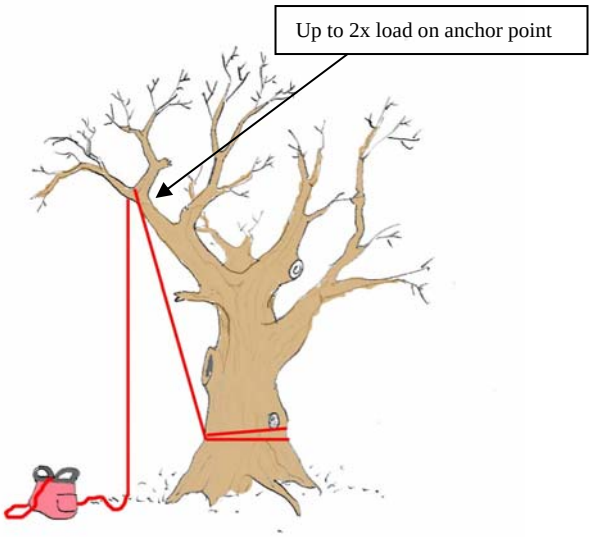
Isolating a branch is the process of manipulating the throwline or climbing rope such that both sides of the line hang parallel next to each other all the way to the ground, with no other branches or foliage between them. This is necessary if you plan to use an access method (body-thrust; footlock) which requires both sides of the rope for climbing.



1.1 SOME DIFFERENT SETUPS

There are several ways to tie off an SRT line for climbing, and it is worth going into them in greater depth as they generate very different forces on the tree, but also give a range of options for the climber.

1: Tied off at the Base

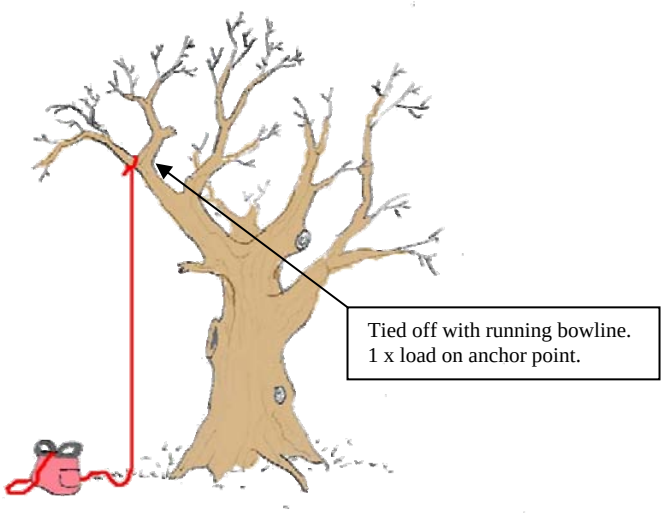


This is by far the most common method of SRT tie-off. The great advantage is that you do not need to isolate the target branch in order to install the line. Because the line is tied off at the ground, it is easy to remove from the tree at the end of the climb. In addition, this setup gives you the option of including various types of **rescue setup** (see Appendix I).

The main disadvantage is that it is possible to generate up to **double the load** on the anchor point. A more thorough discussion of force vectors and their applications in tree climbing can be found on the VTIO website and in Appendix II; for now it is enough to say that when the two sides of your access line are hanging parallel from an isolated anchor point and one is tied off at the base, climbing on the other will generate **double the load** on the anchor point.

The only other disadvantages of this setup are that you have two sides of the access line to deal with whilst conducting work in the tree, and should you need to be rescued **your rescuer has to have SRT gear in order to use your access line**.

2: Tied off at the Anchor Point

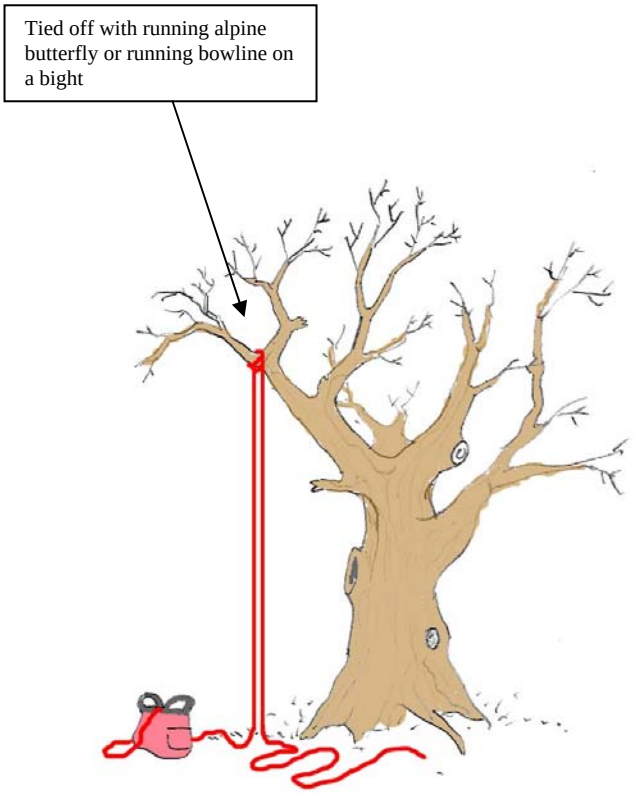


This setup has two big advantages. Firstly, only a single load is generated at the anchor point. Secondly, you have only a single line to avoid whilst working in the tree. The disadvantages are that the target fork has to be isolated in order to install the line; the line is not removable from the ground at the end of the climb; and the tree can only be accessed using SRT equipment, in other words should you need to be rescued **your rescuer has to have SRT gear in order to use your access line**.

3: Tied off at the Anchor Point with a Running Alpine Butterfly

The alpine butterfly is commonly used like this to pull both sides of a footlocking line together, however it is equally useful in order to lock one side of the line for SRT. This setup is removable from the ground, both sides of the line hang together rather than being in the way, and it generates only a **single load on the anchor point**. Another great advantage is that **other climbers can access the tree without needing SRT gear**, either by footlocking on the doubled access line or by pulling out the alpine butterfly and body-thrusting up the line.

How to tie the Alpine Butterfly
From Wikipedia



1.2 CHECKING YOUR SETUP

One of the main risks of SRT, along with any access method that relies on installing a line high into the tree, is that it is very hard to inspect your anchor point before leaving the ground. Particularly in tall trees, or trees with dense canopies or a lot of internal growth, the anchor point may be hard to see. **It is critical that you ensure that you are over a sound and sufficient anchor point before leaving the ground**. This can be done by visual inspection, possibly using binoculars, or by performing an on-rope 'bounce' test.

Remember that if you are tying off the line at the base, you may be double-loading your anchor point. In this instance, checking your anchor point by getting additional climbers to load your line must be done by both loading the climbing part of the line. It is no good one of you hanging on each side, as this is the same load as you will be applying when you tie off and start climbing. Be aware that 'bounce testing' or multiple loading may cause upper-canopy failures, so be ready to move away.

Single Rope Technique is a strong and efficient method of tree access. It does have some drawbacks, however. Almost all are related to the risks inherent in the installation of a climbing line high in a tree, over an anchor point that may be hard to see from the ground. Particularly in trees where the climber has found it hard to install a line, there may be a temptation to accept an anchor point whose safety and sufficiency is hard to determine. Take the time to check it again, and if you aren't confident then throw again for something lower! **In some trees it may not be possible to use SRT; a traditional method of access may be preferable**.

In addition, new SRT users should practice an on-rope changeover to a suitable descent device several times near the ground before beginning SRT climbing. The tree may contain insect swarms or other such unforeseen hazards, and with some SRT systems the changeover to a descent device can be involved and time-consuming. New users should also consider the use of a **rescue setup**, similar to the one shown in Appendix I, which allow the climber to be lowered to the ground in the event of difficulty.

2 SRT SYSTEMS

There are an enormous variety of SRT systems on the market, with innovative climbers mixing and matching equipment and kit in order to create their own customised setups. Familiarity with the general principles of SRT is very important before going on to customise your own setup, however. (Please see 'Building Your Own System', below).

The list of systems given in this section is by no means intended to be exhaustive. Many popular and successful systems are not shown, simply because the author is not familiar with them. The systems shown are briefly discussed, and the main advantages and disadvantages of each mentioned. Each system is also scored in four categories, an example of which is given below.

2.1 TEXAS SYSTEM

Lightweight		Describes a key feature of the system
Efficiency	☻	(More points = climber uses less energy to climb)
Speed	☻ ☻	(More points = climber goes rapidly up the access line)
Gear	☻ ☻ ☻ ☻	(More points = less gear required, gear is less bulky)
Setup	☻ ☻ ☻ ☻	(More points = faster to get on and off)
(attach 2 ascenders, etc)		(Describes actions required to set up and engage system)

These ratings are the result of personal opinion and are by no means definitive. Different combinations of equipment and ropes may well be giving other climbers very different results with the same system. The preference for an SRT system is very personal, and is the result of climbing style, physical aptitude, body shape, experience and technique. The aim of providing this scoring system is not to claim that one system is any way better than another, rather simply to provide climbers who are unfamiliar with a particular system the opportunity to consider some of its strengths and weaknesses before deciding to invest in yet more equipment!

When choosing an SRT system, consider the use you will be putting it to. Do you climb a lot of very tall trees and value speed and energy efficiency, or are you looking for a system which is quick to get on and off the line for repeated short ascents? Will the system be packed away and carried or left on the line to be lowered out at the end?

Building Your Own System

The most important point is that whatever setup you are using, if using mechanical ascenders **you must maintain two points of attachment to the line at all times**. These must both be rated for life support, and if you are using a prussik loop as part of your system it must be sited above the highest ascender in the system (a failed ascender would simply push any prussiks below it along the line). In addition, failure of either of the two points of attachment must not render the climber liable to a fall of greater than 500mm before the second point of attachment engages.

2.1 TEXAS SYSTEM

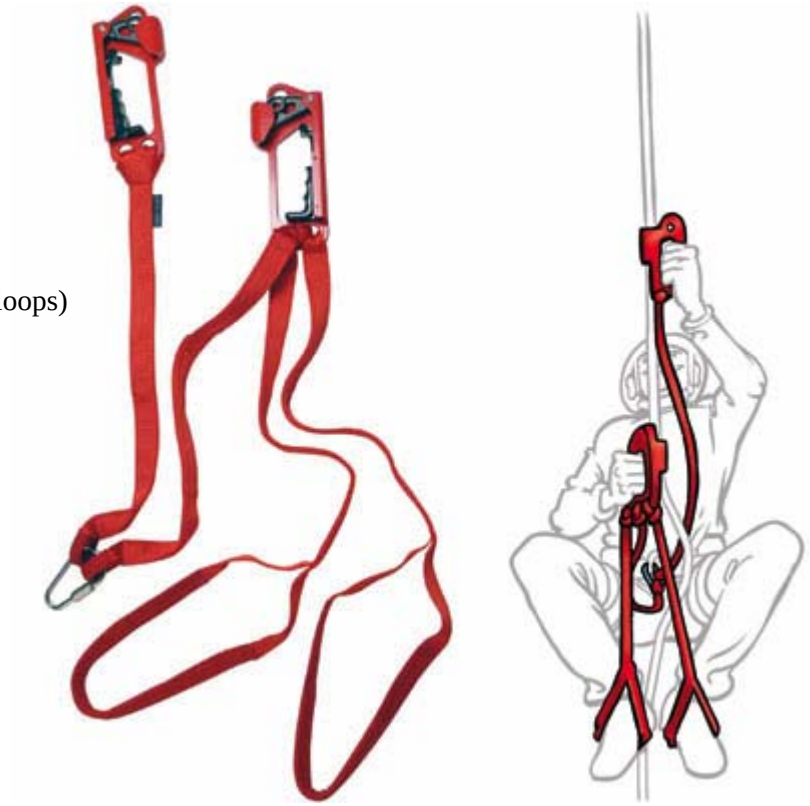


Image © SherrillTree

Lightweight, quick on and off.

Efficiency ☻
Speed ☻
Gear ☻ ☻ ☻ ☻ (900g)
Setup ☻ ☻ ☻ ☻ ☻
(attach 2 ascenders, 1 'biner, footloops)

Ingredients:
2 x hand ascenders
Webbing slings as picture
1 x mallion or karabiner

Advantages
Simple
Really quick to get on and off
Requires a minimum of gear
Packs away quickly

Disadvantages
Sit-stand method is physically demanding and very slow

As described above, this system is great for getting on the line quickly and for packing away fast when you get where you are going. A variation on this system (only one large footloop) is used by the tall-tree scientists in the redwoods, who need to get on and off the line frequently and don't want to spend too much time setting up and packing away gear.

Where do I get it?
All of the items listed in the ingredients are available separately, or the exact system shown above can be ordered from the HSherrillTree websiteH

2.2 TREE FROG SYSTEM

Image © SherrillTree

Lightweight, efficient

Efficiency ☻☻☻
Speed ☻☻☻☻
Gear ☻☻☻ (820g)
Setup ☻☻☻
(attach 3 ascenders, 2 'biners, footloop, install secur, put on pantin)

Ingredients:
Hand ascender
Chest ascender
Foot ascender
Petzl Secur
Slings and connections as shown, + 2 'biners

Advantages
Simple
Reasonably quick to get on and off
Requires not too much gear
Packs away reasonably quickly

Disadvantages
Over long ascents can be hard work on the arms; doesn't leave hands free to move folige, etc
As shown above, Petzl Secur is time consuming to attach.
As shown above, Petzl Secur, Croll & Pantin worn throughout climb

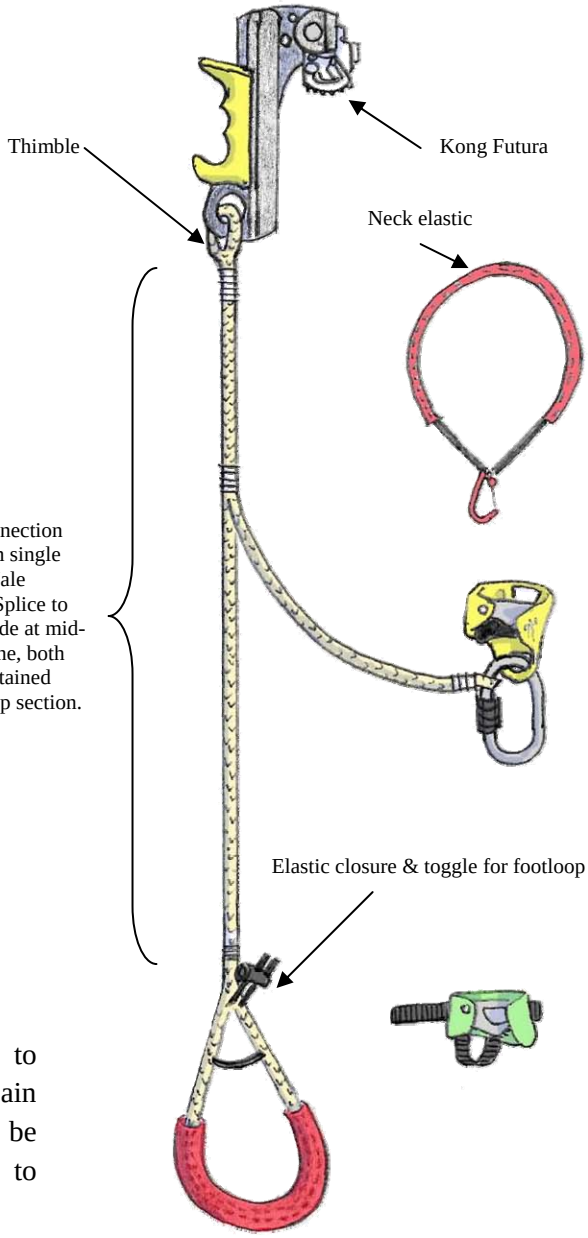
This system and variations on it are by far the most common seen, at least here in Victoria. And for good reason. A nice balance of speed, energy efficiency and simplicity without using too much gear. As shown above the system is adjustable to fit different sizes of climber, but it would be possible to cut weight by replacing some elements with custom-spliced variations, once you knew the correct lengths. There are lots of variations of this system, the most common being to replace the Secur with a neck or chinstrap elastic, or to advance the chest ascender directly from the hand ascender.

Where do I get it?
All of the items listed in the ingredients are available separately, or the exact system shown above can be ordered from the HSherrillTree websiteH

2.3 MICROFROG

Lightweight, efficient

Efficiency ☻☻☻
Speed ☻☻☻☻
Gear ☻☻☻☻
Setup ☻☻☻☻
(attach 2 ascenders, 1 'biner, footloop, Pantin)



Ingredients:
Hand ascender
Chest ascender
Foot ascender
Custom spliced connection, + 1 'biner

Advantages
Very simple & lightweight
Quick to get on and off
Requires not too much gear
Packs away quickly

Disadvantages
Over long ascents can be hard work on the arms;
doesn't leave hands free to move foliage, etc
Requires complex custom splice.
Foot ascender worn throughout climb

Custom-spliced Tree Frog variation designed to minimise weight without losing efficiency. The main disadvantage is the complexity of the splice. Can be made in Vectran or similar, which is much easier to splice but frays.

Where do I get it?
All of the items listed in the ingredients are available separately. A variation on the system shown will be available at the VTIO workshop, or through Hthe Atraes WebsiteH

Credit is due…
This Tree Frog variation is a Joe Harris and Scott Sharpe production…

2.4 ROPE WALKER II SYSTEM

Image © SherrillTree

Extremely efficient and fast
(not used by this author: scores based on hearsay and use of similar variation)

Efficiency ☻☻☻☻☻
Speed ☻☻☻☻☻
Gear ☻ (1630g)
Setup ☻
(Put on chest box & harness, tie klemheist, connect 2 ascenders, footloops and elastic)

Ingredients:
Rock Exotica single chest roller
2 x chest ascenders
Prussik loop
Elastic

Advantages
Very energy efficient and fast

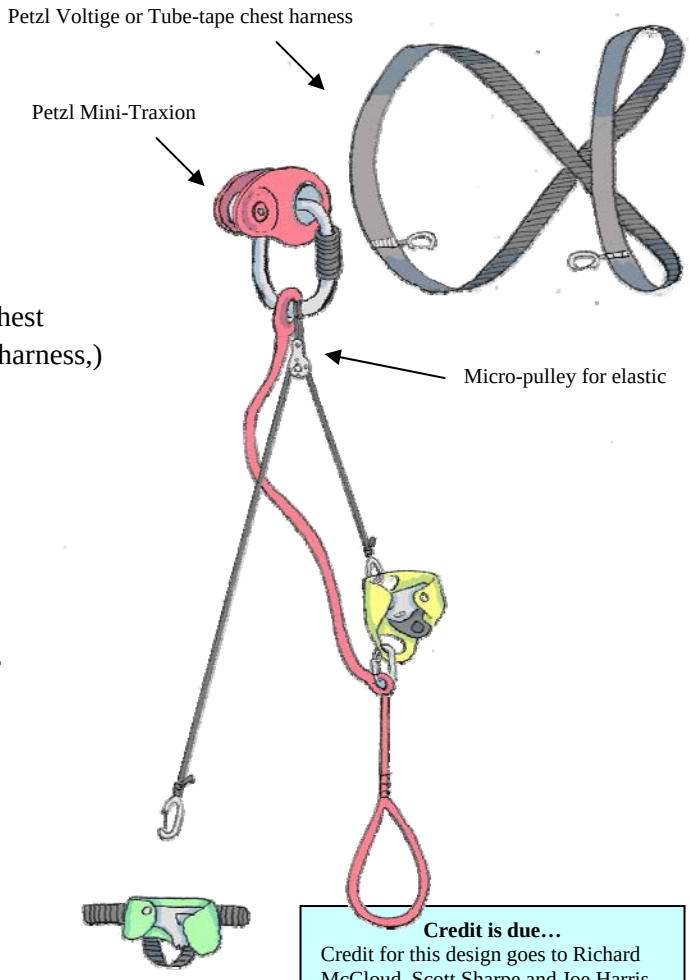
Disadvantages
Time consuming and complicated to set up and remove
All the gear has to be packed away and carried for the rest of the climb

According to Sherrill: "*This is a veteran system that we recommend to highly trained climbers performing very long vertical ascents. It's the fastest and most physically efficient rope ascending system around and has earned the climbers that swear by it virtually all SRT speed climbing records. However, as we caution those speed-seeking newbies, it is difficult and time-consuming to engage and disengage from the line, requires precise adjustment and is cumbersome to carry.*"

The Greenwood Supremacy
Add the chest roller from this system into a Tree Frog (use to advance Croll instead of Secur or Neck Elastic) for a Long-Range and energy efficient Tree Frog…

Where do I get it?
All of the items listed in the ingredients are available separately, or the exact system shown above can be ordered from the HSherrillTree websiteH

2.5 ROPE ROCKET SYSTEM



Lightweight, extremely efficient

Efficiency ☻☻☻☻☻
Speed ☻☻☻☻☻
Gear ☻☻☻☻
Setup ☻☻

(Petzl Mini-Traxion + 2 ascenders, put on chest harness & Pantin, connect elastic and chest harness,)

Ingredients:

Petzl Mini-Traxion
Chest ascender
Foot ascender
Chest harness (eg Petzl Voltige)
Elastic
Slings and connections as shown, + 1 'biner

Advantages

Lightweight
Very energy efficient and fast
Requires not too much gear
Packs away very small

Disadvantages

Time consuming and complicated to set up and remove
Mini-Traxion has to be removed from karabiner to remove system from line
Chest harness & foot ascender worn throughout climb

Credit is due…
Credit for this design goes to Richard McCloud, Scott Sharpe and Joe Harris

A Rope Walker variation designed to minimise gear requirements whilst keeping speed and energy efficiency at a premium. Great for long ascents, as the climb is very energy efficient and the system packs away into a chalk bag for the rest of the tree: no bulky chest box or hand ascenders to be carried around or lowered out at the end.

The Frog Rocket
Swap the chest harness and Mini-Traxion into a Tree Frog or Tree Tempo (replacing Croll & Secur) for a Long-Range Tree Frog…

Where do I get it?
All of the items listed in the ingredients are available separately. A variation on the system shown will be available at the VTIO workshop, or through Hthe Atraes WebsiteH

2.6 R.A.D. SYSTEM

Ascends and Descends
(not used by this author: scores based on hearsay)

Efficiency	☻ ☻ ☻
Speed	☻ ☻
Gear	☻ ☻ ☺
Setup	☻ ☻ ☻

Ingredients:
Petzl ID, Gri-Gri or similar
Hand ascender
Small pulley
Foot strop
3 'biners

Advantages
Lightweight & simple
Gri-Gri can be used to descend
Option to work from Gri-Gri

Disadvantages
Sit-Stand method is time consuming
If using just for access, Gri-Gri or ID relatively large

An SRT variation which allows for rapid-changeover to descent; simply remove the rope from the pulley on the hand ascender, take your foot out of the footloop and you're good to go. Some climbers are also choosing to use the Gri-Gri to work throughout the tree, returning the hand ascender to the line when they wish to re-ascend.

The techniques involved with working from a static single line will be covered in later revisions to this handout.

3 WORKING WITH SRT

The setups involved with SRT are more than just a way of accessing the tree, as they can lend themselves to a wide range of climbing possibilities… and hazards. The installation of an access line, whether it be for footlocking or for SRT, is an extremely strong option for a lot of reasons when working in larger trees. The most important reason is the facility with which other climbers can then enter the tree, whether to assist with the work or to rescue the original climber. **If you need to be rescued, the other climbers may get to you much quicker if you have installed an access line prior to starting work.** In addition to this, you will be able to use the access line to return to your anchor point when starting work in a new part of the tree, or returning to work after a big lunch.

The major downsides of having an access line in the tree are the problems involved with snagging branches on the line, or of getting it tangled with rigging or climbing ropes. For this reason it is uncommon for access lines to be installed during a removal, when the climber has entered the tree on spurs. Do consider however whether the installation of an access line might be a good option when doing a removal, if it is possible to install it in a manner that will not interfere with branches being lowered.

As stated previously, if you wish to use SRT to enter a tree, it is **critical that your rescue climber is familiar with and has access to suitable SRT Gear**, or that the access line is set up in such a manner that should you be injured your rescue climber will still be able to use it to enter the tree in their preferred manner.

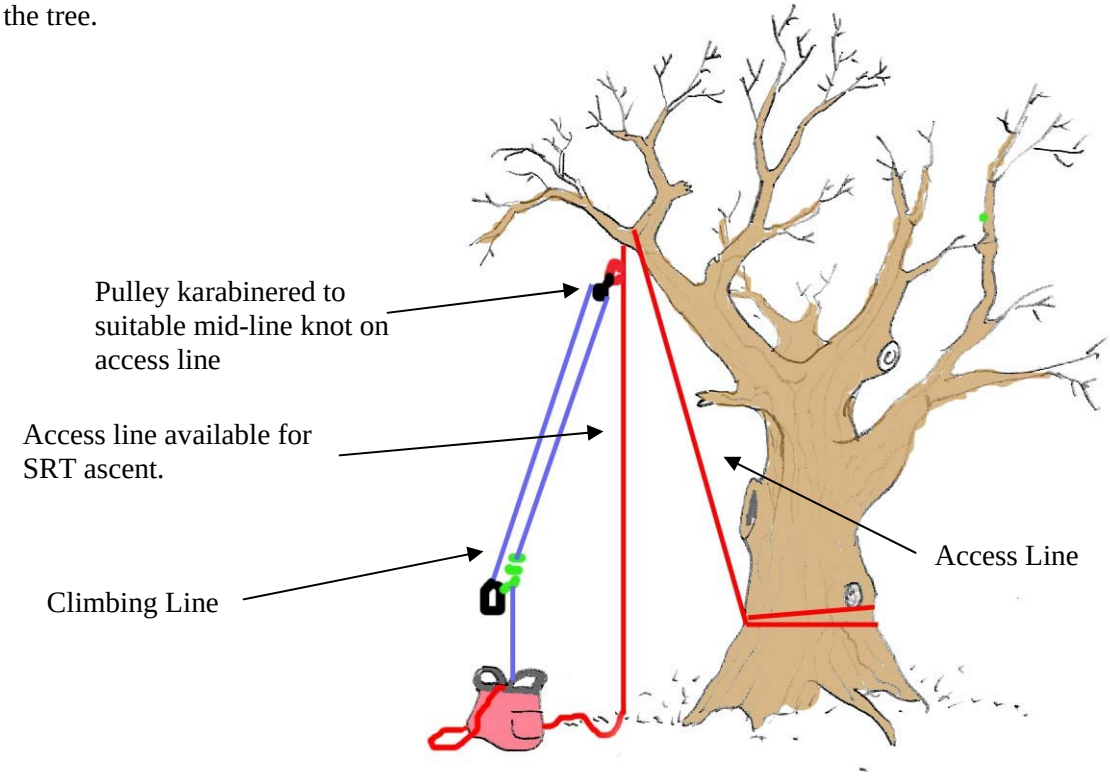
Many SRT systems can also be configured for use to aid ascent in a doubled-rope climbing system. By using your SRT system on the prussik side of the climbing line, you will be able to advance up the rope. The smoothness of this technique, and the amount of time required to set it up, will vary hugely depending on the specifics of your SRT setup. Do try it out though to save energy instead of a long body-thrust!

3.1 SETTING ON THE ACCESS LINE (I)

A very efficient way of using the access line when planning to work in quite a localised area of the tree is to **set on the access line**. This is illustrated in the picture below. This is a powerful and efficient technique, but climbers should be wary of some inherent risks.

Setting up like this can place up to **twice your load on the anchor point**, which you will not have climbed to inspect. Also, your entire **system is vulnerable to anything** (falling branch, chainsaw cut, groundie) **which affects the tied-off section of the line**. These are very serious concerns!

The great strengths of this technique are that it is quick to set up, and allows the installation of a friction-free anchor point without isolating a target fork or having to climb to the top of the tree.

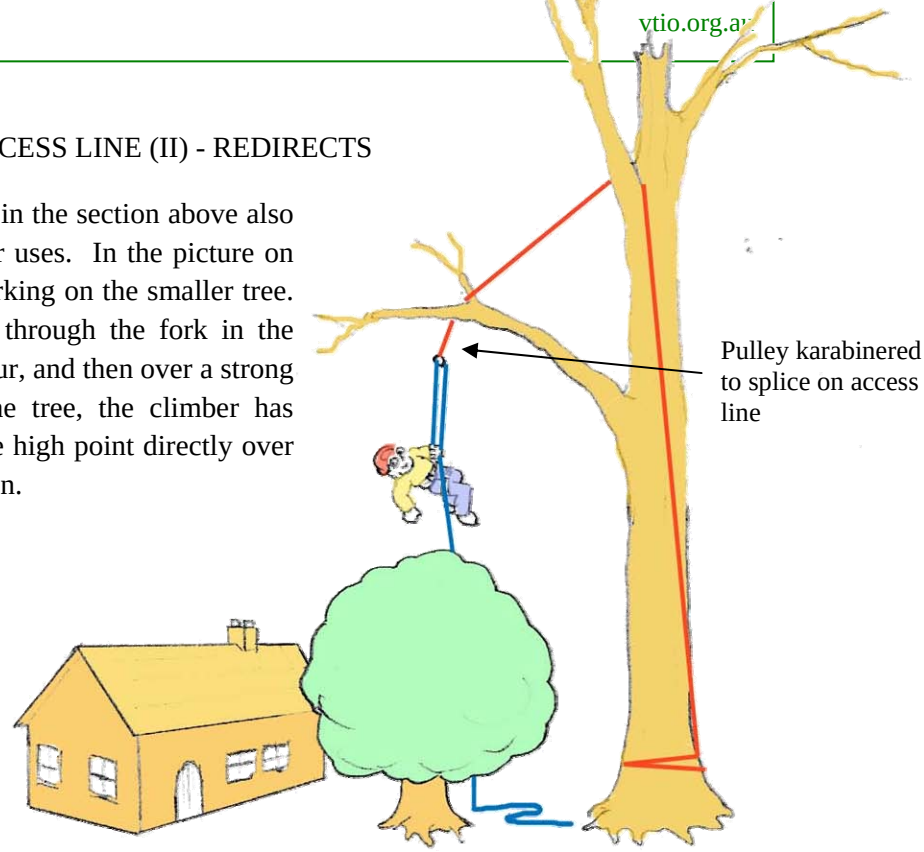


Note: "*Neither an engaged, frame loaded toothed ascender nor a cam-loaded non-toothed ascender shall be permitted* [to be used as the connection point for an anchoring system]. *Fall protection anchoring systems must include an approved stopper knot or hitch on the static line below the anchoring system,* ***unless the climbing system is directly connected to an approved knot in the access line.***

International Tree Climbing Championship Rule Book, 2010

3.2 SETTING ON THE ACCESS LINE (II) - REDIRECTS

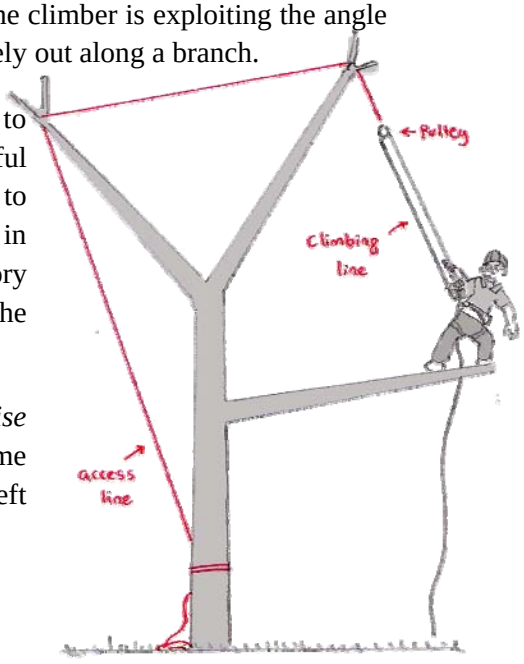
The setup technique shown in the section above also lends itself to further clever uses. In the picture on the right, the climber is working on the smaller tree. By setting the access line through the fork in the branch of its larger neighbour, and then over a strong branch in the centre of the tree, the climber has given himself a friction-free high point directly over the tree he will be working in.



3.3 SETTING ON THE ACCESS LINE (III) – FORCE VECTORS AND ACCESS LINES

The additional force applied at the anchor point by tying off one side of the line and climbing on the other was mentioned briefly in the setup section. It is however possible to use an understanding of **force vectors** to greatly improve the loading on an anchor point. .

The picture below illustrates one such potential use, where the climber is exploiting the angle formed between two anchor points to allow him to climb safely out along a branch.

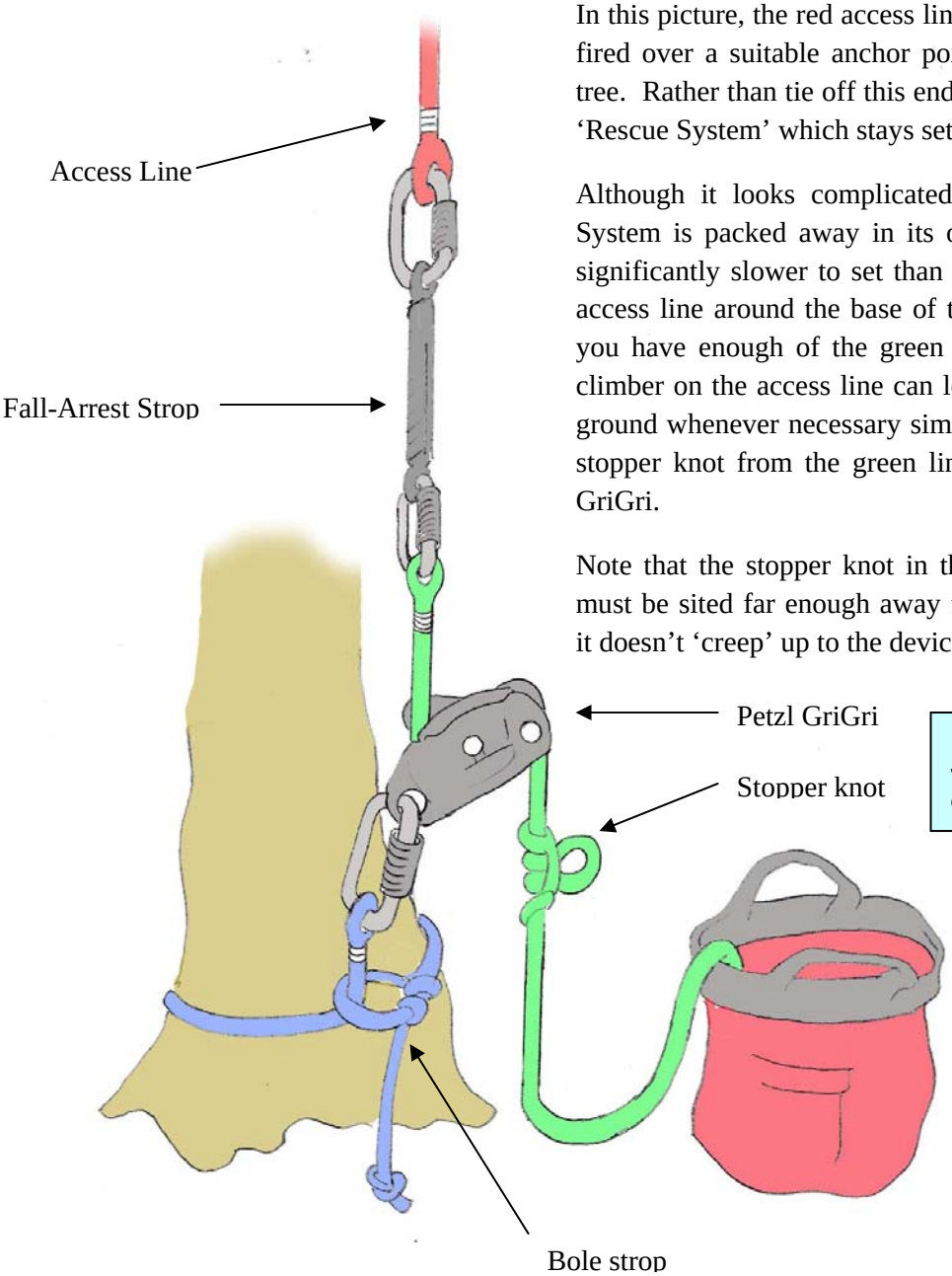


Setups like this which use an understanding of **force vectors** to improve climbing safety and efficiency are very powerful options, but require a thorough knowledge and familiarity to use well. Climbers unfamiliar with the use of force vectors in climbing and rigging should read the VTIO introductory document, Working the Angles, available separately on the website or abridged in this document as Appendix II.

Whilst the setup shown is extremely strong in the *precise* direction that the climber has headed, it would become extremely weak if the climber were to head up toward the left hand fork.

APPENDIX I – RESCUE SETUPS

The setup shown below, or variations thereof, are designed to allow the climber to be lowered out of the tree from the ground in the event of being incapacitated whilst on the access line. This particular setup contains a break-away lanyard to absorb shock in the case of a fall on the access line. Setups like this are a good option when introducing climbers to SRT, as they can be lowered safely to the ground if they are unable to proceed or change to a lowering device.



In this picture, the red access line at the top has been fired over a suitable anchor point at the top of the tree. Rather than tie off this end, it is attached to the 'Rescue System' which stays set up on its own line.

Although it looks complicated, the entire Rescue System is packed away in its own bag, and is not significantly slower to set than simply tying off the access line around the base of the tree. So long as you have enough of the green rescue line spare, a climber on the access line can lowered safely to the ground whenever necessary simply by removing the stopper knot from the green line and actuating the GriGri.

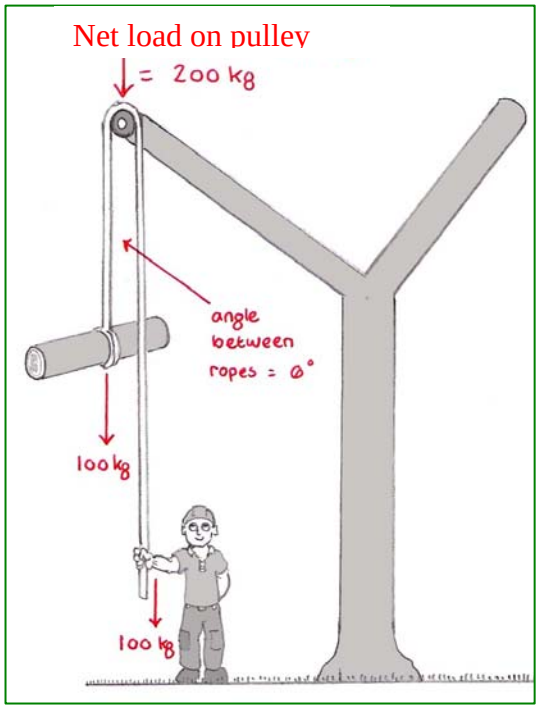
Note that the stopper knot in the green rescue line must be sited far enough away from the GriGri that it doesn't 'creep' up to the device and jam.

Credit is due…

This extra-safe setup was designed by Scott Sharpe

APPENDIX II – FORCE VECTORS (Abridged from "Working the Angles")

Take a look at the diagram on the right. It's a fairly common scenario in most removals: the climber has snatched off a large piece, and the groundie has brought it to a gentle stop with the lowering rope. Leaving aside for the moment any questions of shock loading, friction, and elastic elongation, how much load is on the pulley?



Almost any experienced climber will tell you straight away: "there's double the weight of the log." It seems fairly straightforward, but it's worth going into it in more depth.

The log weighs 100kg. As it is not plummeting to the earth something must be pulling in the other direction with the same force to keep it in place (Newton's Third Law). In this case it is clearly the rope which is holding the log in the air.

Over on the other side, the groundie is having to put his whole 100kg of weight on the rope to balance out the weight of the log.

It's fairly easy to see that in this simple example, where both sides of the rope are pulling down on the pulley with a weight of 100kg, there is a **net load on the pulley of 200kg**.

To put it another way, when one side of a rope is loaded and the other is locked off,

Ropes running parallel = double the force on the anchor point

This simple statement is really important, and has a great many practical repercussions in tree climbing. The most common examples are rigging scenarios like the one shown above, **and the classic Single Rope Technique setup of one side of the access line being secured to a ground anchor in order to make the other side ready for climbing.**

"Shouldn't we be talking about forces instead of weights?"

In all of the examples in this appendix the loads are discussed purely in terms of weights. **This isn't strictly accurate**, as to work things out properly we should move across into Newtons and use genuine **force vectors**. This way is much simpler, however, and gives basically the same results.

Climbers interested in looking into these problems in greater depth should check out 'Working the Angles", available for download from the HVTIO websiteH.

ROPE ANGLES AND FORCES

So far, so easy. As we saw on the previous page, lowering a section of timber whilst your groundie stands directly underneath causes a force on the pulley of double the weight of the piece being lowered. This is about as far as many climbers go with working out forces, and it is certainly far enough to remove just about any conceivable tree. Simply put your rigging point on the main stem somewhere up near the top of the tree, and then use it to lower off as large a bit as you think it can handle.

THE ANGLE RULE:

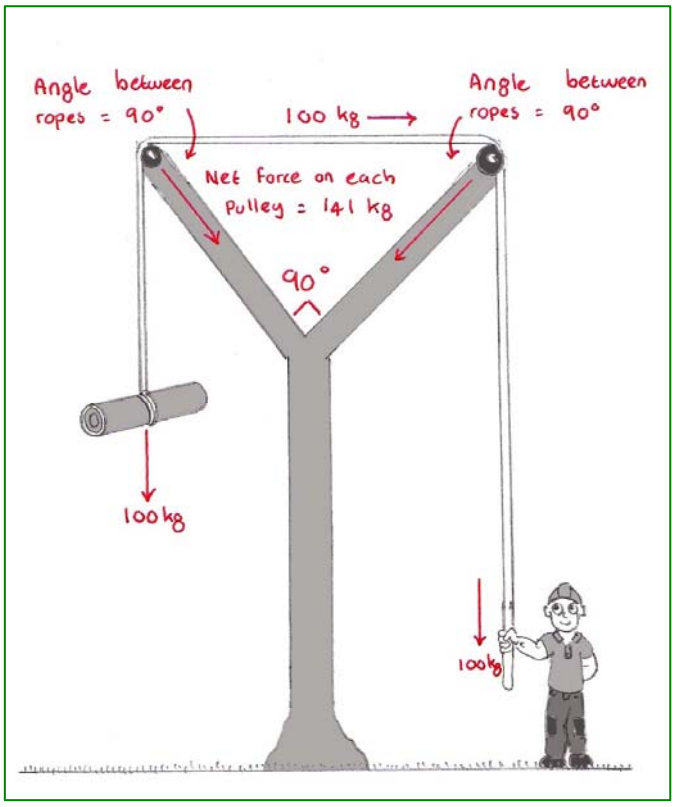
The resultant force of a rope passing over a point bisects the angle made by the rope at the point.

THE FORCE RULE:

The wider the angle made by a rope passing over a point, the less force the rope applies to that point.

But we can do better. **The Angle Rule**, given above right, is a fantastic and simple mental tool to carry in your head when thinking about the forces that your climbing and rigging are going to apply to the tree.

In the picture below, the same log is being held up by the same groundie. But the setup, and the forces being applied on the tree, have completely changed. By adding a second pulley into the system on the right-hand head the climber has hugely improved the situation. In fact, **the weight applied on the tree at each pulley is greatly reduced** (**The Force Rule**), but we'll get to that in a minute. For now, the most important thing to look at in the picture is the **direction in which the weight is applied.**



As you can see, the lowering rope is making a right-angle at each pulley. A quick look at **The Angle Rule** above will remind you that where two forces are pulling at angles to each other, the **net resultant force bisects the angle between the two forces**. In other words, it pulls exactly half-way between the two of them.

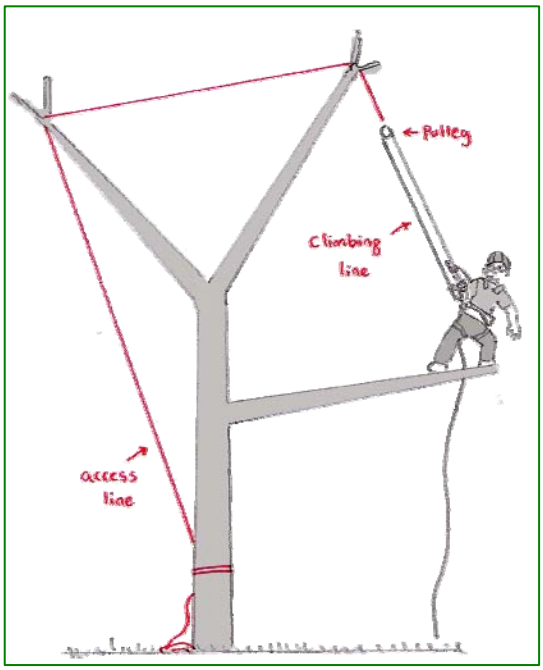
Half of 90° is 45°, so the resultant force on the pulley acts at 45° from the line of either rope. In this case, that means it is acting **exactly along the branch**. Perfect compression force!

And another thing…

Some of you may already have spotted the other great advantage of this setup, which is that the groundie is no longer standing directly under the log being lowered.

APPLICATIONS OF THE ANGLE RULE

The picture on the right, as we saw in the previous section shows a climber making good use of the Angle Rule. He wishes to climb out along the branch on which he is standing, and has no work to do anywhere else in the tree. Why is his setup so good?



Look at the force being applied at both of the forks which his access line passes through. In each case, the net force on the stem acts close to **directly along the stem**; in other words the net force on each stem is almost completely compression force.

Now imagine that the climber had simply set on the right-hand fork in the traditional manner. There would of course be no force applied at all on the left-hand stem. There would also be **less total force applied on the right hand stem**, as the climber would be applying only the single load of a normal setup. The important factor in this instance, and the reason why this setup works so well, is the **direction (vector) of the force.**

Imagine a tree similar to the one shown in the picture (maybe with a few leaves and some more branches!). Both *Corymbia citriodora* and *Eucalyptus cladocalyx* often present similar challenges to climbers, so for the sake of the example picture the tree as a spreading, skinny lemon-scented gum (a great example if you know it is the large *citriodora* in Deepdene, on the east side of Burke Rd., near the intersection with Whitehorse Rd.). Think of that right-hand stem as a long smooth rising leader, branching at the top into sparse foliage.

Now imagine the way in which it would move if the climber was pulling sideways on it using a traditional setup. It would flex and bend alarmingly to the right.

Using this setup, the stem would be moved about a bit, but (so long as there wasn't too much friction where the access line passes through the fork) the whole setup would feel very reliable and secure.

Warning

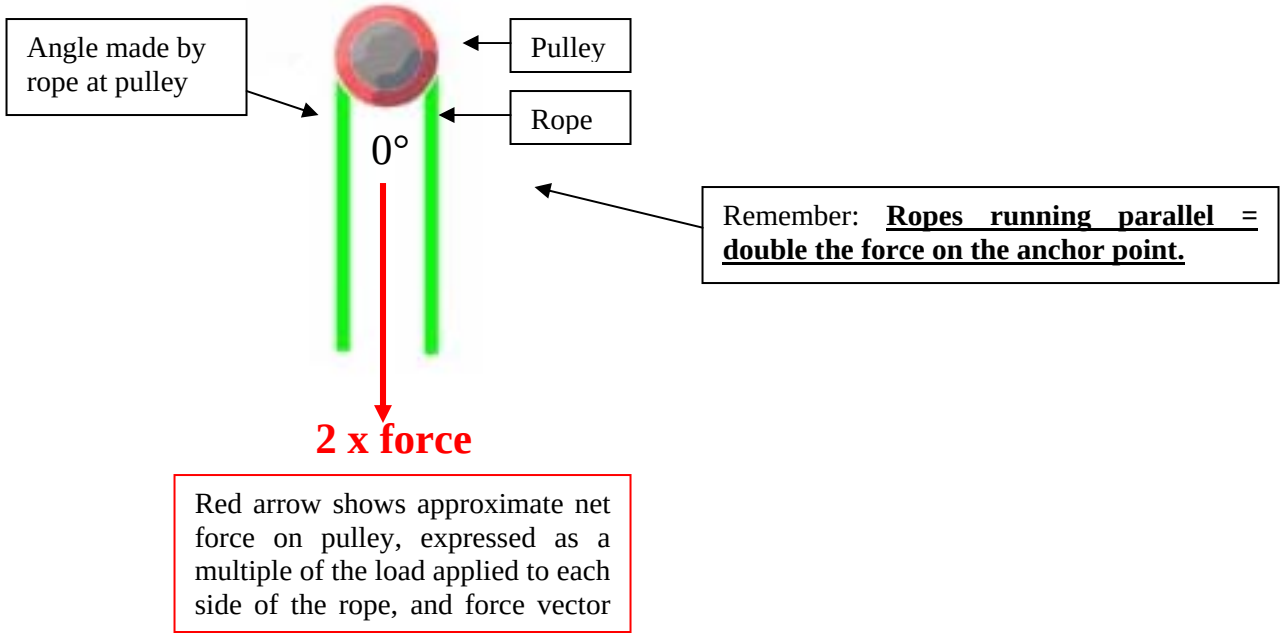
The setup shown in the diagram above is extremely strong **only for the direction in which the climber is currently heading.**

If he decides to go up and prune a bit out of the left-hand head, **this setup becomes extremely weak**. Imagine the force that would be applied to the right hand fork once he reached the left hand head. Remember **Ropes running parallel = double the force on the anchor point.**

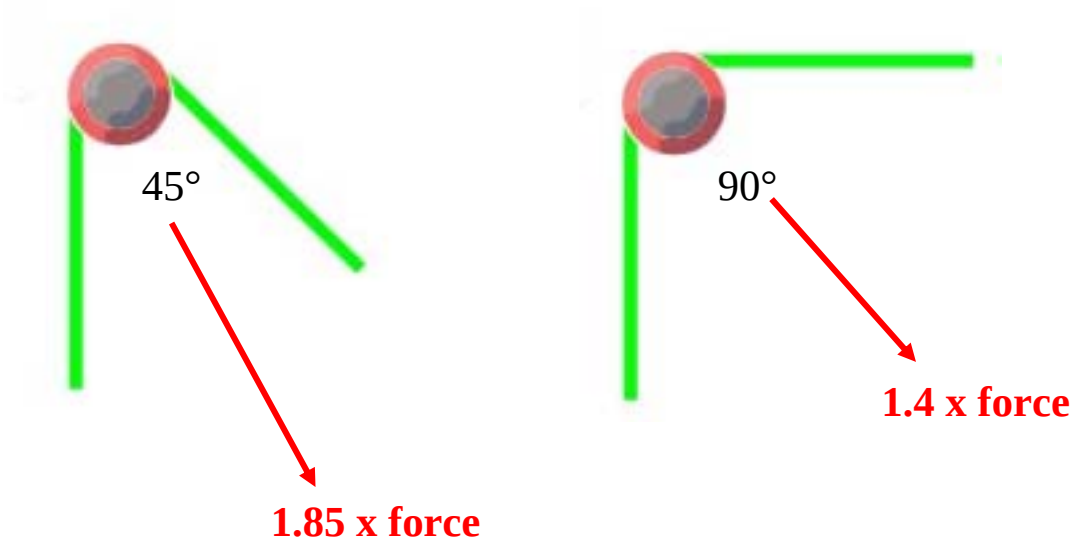
THE FORCE RULE; SOME EXAMPLES

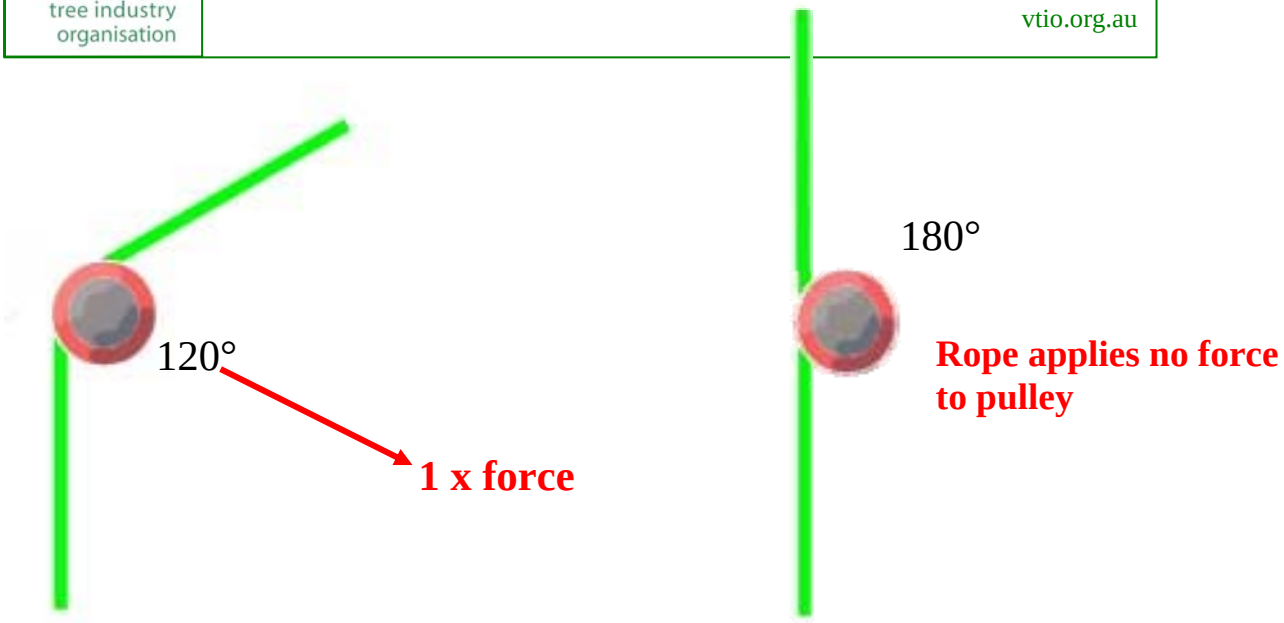
THE FORCE RULE:

The wider the angle made by a rope passing over a point, the less force the rope applies to that point.



Red arrow shows approximate net force on pulley, expressed as a multiple of the load applied to each side of the rope, and force vector





THE FORCE RULE IN PRACTICE

Let us return again to the picture shown on the right. We saw how **The Angle Rule** meant that the force on each pulley acted exactly along the branch. We can now use **The Force Rule** to work out that the wider the angle made, the less force applied. And in the picture to the right, because the angles match up neatly with one of the examples above, we know approximately how much force is actually being applied at each pulley.

For an in-depth look at this and other force problems, and the tools to work with a range of force vector results, please download Working the Angles from the VTIO website.