



The information in this Best Practise Guide was accurate and reliable at the time of writing and does not supersede legislation or the recommendations of equipment manufacturers.

Best practice guidelines for Silvicultural Pruning

Vision, knowledge, performance



He Mihi

Nga pakiaka ki te Rawhiti.

Roots to the East.

Nga pakiaka ki te Raki.

Roots to the North.

Nga pakiaka ki te Uru.

Roots to the West.

Nga pakiaka ki te Tonga.

Roots to the South.

Nau mai, Haere mai

We greet you and welcome you.

ki te Wāonui o Tane

To the forest world of Tane.

Whaia te huarahi,

Pursue the path,

o te Aka Matua,

of the climbing vine,

i runga, I te poutama

on the stairway,

o te mātauranga.

of learning.

Kia rongo ai koe

So that you will feel,

te mahana o te rangimārie.

the inner warmth of peace.

Ka kaha ai koe,

Then you will be able,

ki te tū whakaiti,

to stand humbler,

ki te tū whakahī.

Yet stand proud.

Kia Kaha, kia manawānui

Be strong, be steadfast.

Tena koutou katoa.

First edition July 2000

Revised edition January 2005

This Best Practice Guideline is to be used as a guide to certain pruning procedures and techniques. It does not supersede legislation in any jurisdiction or the recommendations of equipment manufacturers.

FITEC believes that the information in the guideline is accurate and reliable; however, FITEC notes that conditions vary greatly from one geographical area to another; that a greater variety of equipment and techniques are currently in use; and other (or additional) measures may be appropriate in a given situation.

Other Best Practice Guidelines included in the series:

- Cable Logging
- Chainsaw Use
- Fire Fighting and Controlled Burnoffs
- Ground-based Logging
- Land Preparation
- Loading
- Maintenance Inspections of Yarder Towers
- Manual Log-making
- Mechanised Harvesting and Processing
- Mobile Plant
- Personal Protective Equipment
- Road and Landing Construction
- Transport
- Tree Felling
- Tree Planting
- Working with Helicopters

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Best Practice Guidelines for Silvicultural Pruning

Foreword

**AMENDMENT TO THE
BEST PRACTICE GUIDELINE FOR SILVICULTURAL PRUNING**

Forestry is of major importance to New Zealand's economy. It is vital that the forestry industry achieves sustainable productivity gains through developing safe work practices and high-quality workplace environments.

Silvicultural pruning is a labour intensive operation that is applied annually to increase the value and uses of forestry outputs. Those involved need to be fit, trained and skilled to work safely at height with their tools of trade.

The forestry industry has been innovative in improving the design of specialist pruning ladders and chainsaws guarding techniques, substantially improving their safe use in pruning.

In undertaking this revision of Best Practice Guidelines for Silvicultural Pruning the industry has evaluated the risks of injury, techniques, tools used, supervisory and training requirements and determined that it has undertaken all practicable steps in adopting these new operational practices.

I am delighted that the Department of Labour's Health and Safety specialists have been able to contribute to these improvements.

A handwritten signature in grey ink, appearing to read 'Mike Cosman', with a long horizontal stroke extending to the right.

Mike Cosman,
Manager, National Operations,
Workplace Health and Safety,
Department of Labour

December 2004

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Introduction

Purpose of these guidelines

The Best Practice Guidelines for Silvicultural Pruning have been developed by FITEC to improve worker safety and performance. They combine industry training standards and best practice information to provide a valuable reference manual for people involved in silvicultural pruning.

These guidelines should be read in conjunction with the Approved Code of Practice for Safety and Health in Forest Operations. In particular, these guidelines provide direct support for Part 3 - Section 13 (Silviculture) of the code.

They are a valuable reference document for the following Unit Standards registered on the NZQA framework.

Unit 6949 – Demonstrate Knowledge of Pruning Plantation Trees

Unit 6951 – Demonstrate Knowledge of Selecting Plantation Trees

Unit 1243 – Prune Plantation Trees from the Ground

Unit 1244 – Prune Plantation Trees from the Ground in a Production Situation

Unit 1245 – Prune Plantation Trees from off the Ground

Unit 1246 – Prune Plantation Trees from off the Ground in a Production Situation

Unit 6973 – Prune Plantation Trees with a Chainsaw from the Ground

Unit 6972 – Prune Plantation Trees with a Chainsaw from off Ground

Unit 7572 – Prune Plantation Trees with a Chainsaw in a Production Situation

Note: A unit standard covering ultra-high pruning (above 6.0 - 6.5m) is under development and will be available in 2006.

How to use these guidelines

These guidelines have been arranged in two main sections:

- **Silvicultural Pruning Basics** provides information on silvicultural practices and commonly used tools
- **Silvicultural Pruning Procedures** describes specific operations commonly performed by silvicultural workers.

The **Glossary of Terms** gives the meaning of terms used throughout these guidelines.

The **Index to Unit Standards** allows the reader to locate information specific to the relevant Unit Standards.

Acknowledgements

FITEC acknowledges the assistance of the Occupational Safety and Health Service, Liro Forestry Solutions, and numerous forest industry trainers, forestry contractors, and forest company staff in the development of this Best Practice Guideline.

About best practice training material

FITEC has developed the material in this publication. It has been reviewed by representatives of the forest industry. At the time of publication, FITEC considers the practices and approaches in this publication to exceed accepted industry standards with regard to production and business management. In addition, the practices recommended in the publication exceed all the New Zealand regulatory standards, in particular those related to health and safety, environmental management, and human resources / employment as applicable.

This material is reviewed and reprinted regularly by FITEC.

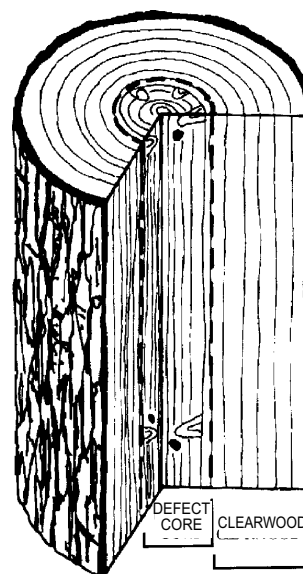
Silvicultural pruning basics

Why do we prune?

Silvicultural pruning is carried out to remove the lower branches of plantation trees. Its primary purpose is to produce clearwood.

Branches are removed from a section of a tree's stem to allow knot-free timber to form around the defect core. This knot-free timber is known as clearwood and continues to form as the tree stem grows over the branch stubs.

Clearwood timber is free of knots and therefore usually stronger. It tends to be used for high quality uses such as veneer, timber mouldings, and furniture.



Pruned tree

Pruning also has the added advantage of improving:

1. Stand health

Pruning the lower branches increases air circulation and reduces humidity, so reducing the spread of *Dothistroma pini*. This disease thrives on the lower branches of the tree in humid conditions. Unfortunately, pruning in some areas raises the risk of infection from *Diplodia* and whorl canker in cypresses.

2. Reducing the risk of crown fire

The chance of fires spreading to the crown of the tree is reduced when the lower branches are removed.

3. Improving stand access

Subsequent forest operations are made easier when trees have been pruned. Vision is increased, access is improved and hindrance is reduced.

Pruning lifts

Each stage of pruning is referred to as a "lift". The height of the pruning lift can be determined by any of the following:

- Overall tree height
- Crown depth
- Distance between whorls (internodes)
- Tree form
- Fixed lift height

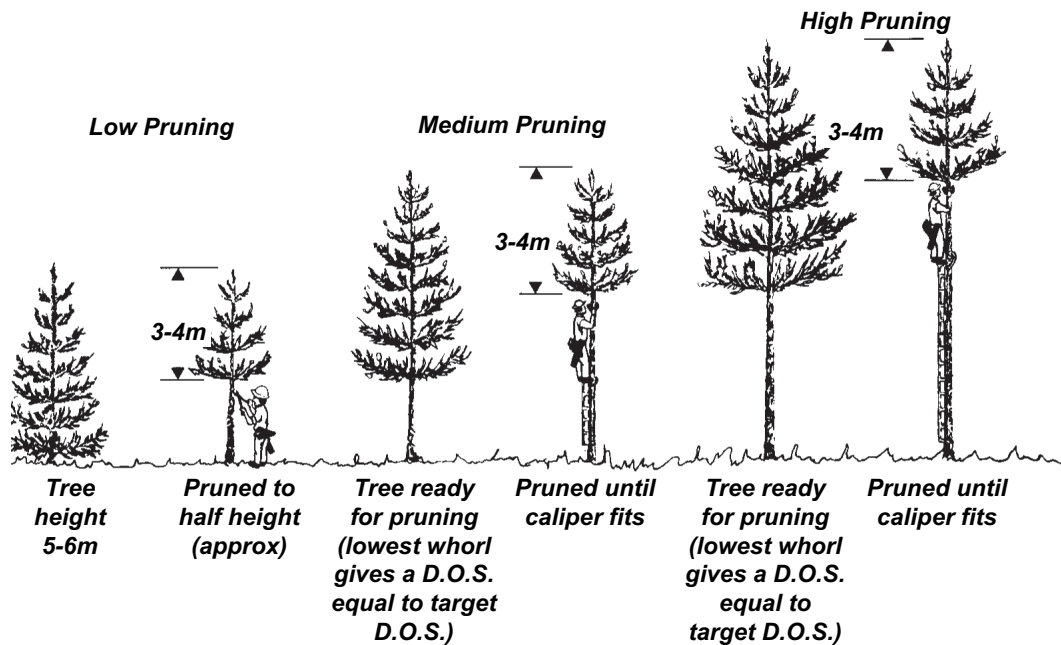
A stand is usually pruned when the average stem diameter at the largest whorl reaches the target DOS (diameter over stubbs). Two or three pruning lifts may be used to produce a 6-metre pruned butt log.

Low prune – up to 2.2 metres or first lift up to 2.4 metres

Medium prune – up to 4 metres. Second lift to 6.5 metres

High prune – up to 6 metres

On higher fertility sites, an ultra high prune may be performed to heights of 8 to 9 metres.



Variable lift pruning

Variable lift pruning is the most common lift used today. It is of major benefit where there is a variation in tree size within a stand.

Each tree is evaluated on its merits and usually pruned until either

- A maximum height is reached, or
- A set stem diameter is reached, or
- A set green crown length is reached, or
- A combination of all three

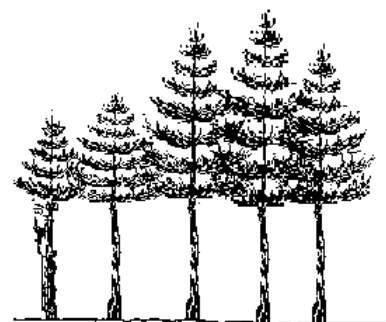


Variable lift

Fixed lift pruning

If there is uniform growth within a stand, fixed lift pruning can be used.

Trees are pruned to a fixed height unless a set green crown height is reached first.



Fixed lift

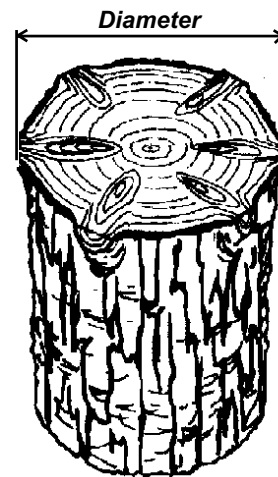
Timing

Timing of pruning lifts is vital if maximum clearwood is to be gained. A target DOS normally sets the programme for pruning operations.

If the interval between pruning lifts is too great, both stem size and branch size will be large. This will result in a large DOS and, therefore, a large defect core. Also, pruning will be more expensive as larger branches mean greater pruning costs. On the other hand, it is also expensive to prune trees too often since it costs money every time a stand is visited. Late pruning may result in due stress on the trees as a larger proportion of the crown is removed in one go.

The way DOS is measured is shown in the diagram.

In some cases tree height and branch size may determine the timing of pruning but this is not common.



Diameter over stubs (DOS)

Pruning equipment

Pruners/Loppers

There are a variety of pruners in use. They generally consist of two handles and a blade and hook that pivot on a centre bolt. The hook simply holds the pruner on to the branch (the blade does the cutting). Before operators modify their pruners in any way they should contact the manufacturer to ensure that the pruners will not be weakened by the modifications.

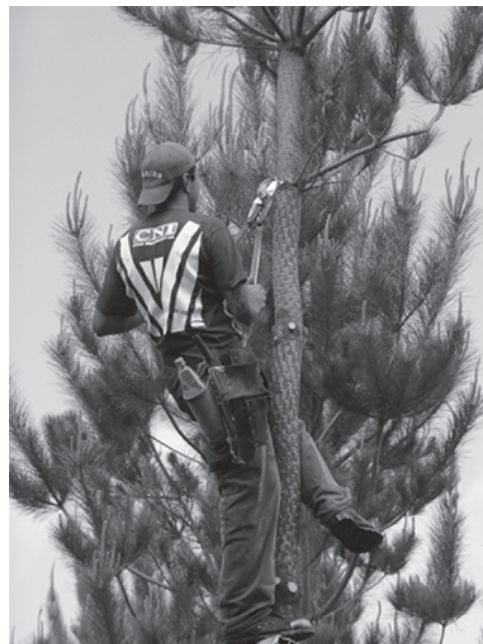
For example, blades should be ground for only very short periods to avoid weakening the steel, and the correct bolts must always be used as low tensile bolts break easily and have caused some serious accidents in the past.

Daily maintenance of pruners

- Tighten bolts to remove slack (reduces bolt and slot wear).
- Adjust centre bolt/star-washer tab as required (ensures clean cuts and less chance of cross-over).
- Inspect the bolt holes in the handles for any signs of fatigue or cracks.



Sharpening of loppers



Pruning with loppers

- Replace bent or cracked handles.
- Ensure the rubber grips are secure (if a grip slips, you could fall from the ladder).
- Clean the blade and hook if necessary and oil regularly.
- Hold pruners securely when sharpening and keep a firm grip of the sharpening stone.
- Make even strokes along the length of the cutter edge.
- One final stroke may be required on the inside edge of the cutter to remove feather-edging.
- Never use a file or grinder on the cutting edge.

Regular maintenance of your pruners will

- Ensure your pruners cut with minimum effort (this lessens fatigue and strain injuries and increases your income).
- Minimise wear and extend the life of your pruners (lowers your costs).
- Reduce breakdowns and lost time.
- Reduce the chance of accidents (you might fall from the ladder if your pruners break).



Jacksaw Pruning

Jacksaws

Jacksaws have a hardened blade, with coarse teeth, held under tension.

The jacksaw cuts best using the push stroke and is generally used to cut the branches that are too large for pruners (this avoids strain injuries).

Daily maintenance of jacksaws

- Tension the blade as required and replace it if it is worn. Loose or blunt blades will not cut straight.
- Overtightening blades will bend the jacksaw frame or break pins.
- Release tension at the end of the day during very cold weather (blades shrink and may crack).
- Lubricate the blade and tightening nut to prevent rust.

Pouch

The belt pouch is used to carry tools. Tools must be carried in the pouch at all times when not in use.

To reduce the chance of injury the pouch should completely cover the blades of all pruning equipment.

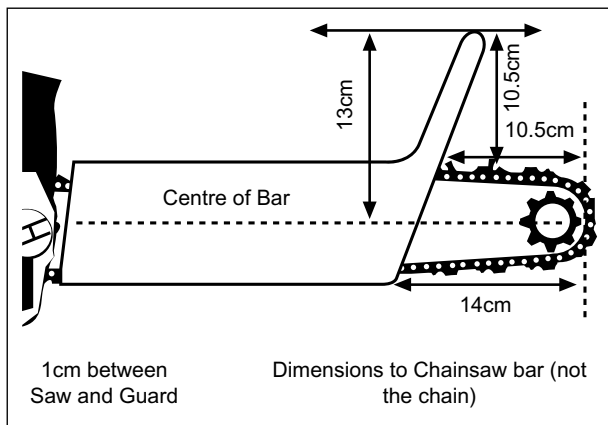
Other pouches can be used to carry drinks, first aid, food, and repair tools.



Belt pouch used to carry tools



**Chainsaw cutter bar guard
(Above & below)**



Chainsaw pruning bar guard

Chainsaws

Pruning with chainsaws may be carried out in stands where large branch sizes make manual pruning more difficult and strenuous.

Research carried out by Liro Forestry Solutions shows that:

- Chainsaw pruning is more hazardous than manual pruning.
- The quality of chainsaw pruning can be lower than manual pruning if care is not taken.
- Chainsaw pruning is more productive than manual pruning.

Care must be taken to make sure that the chainsaw being used has the correct size and capacity to match the task being carried out.

Safety requirements

Operators require the following when they are chainsaw pruning.

- Grade 4 earmuffs, High Viz safety helmet and eye protection.
- Operators must wear chainsaw protective legwear.
- Steel toe capped boots.
- Operators must carry on their person two sterile wound dressings.

A suitable cutter bar guard must be fitted, with dimensions as described in the diagram at left.

When carrying out chainsaw pruning from a ladder the operator must have a suitable system to attach the chainsaw to the operator's belt. The attachment should be in the form of a flattened blade hook.

Saws must be of top handle design, and 40cc or less in capacity.

The forest company may require High Viz vests to be worn.

Daily maintenance of your chainsaw

- Remove the air filter cover and operate the choke lever to close off the carburettor entrance.
- Remove the air filter and clean it with a soft brush, petrol, and/or warm soapy water.
- Check carefully for light patches or broken gauze. Ensure that the filter is dry before replacing.
- Replace the filter if it is worn or damaged.

Periodic maintenance of your chainsaw

- Remove the bar and chain from the saw body.
- Visually check the bar, chain, and sprocket for unusual wear patterns.
- Clean bar groove and oil holes.
- Inspect and grease the sprocket nose bearing. Remove burr when necessary with a flat file.
- Clean the external saw body, especially around the clutch cover area and the oilway.
- Check and tighten every screw and check the anti-vibration mounts.
- Make sure none of the covers are damaged and that they are secure. They are part of the cooling system.
- Fit the guide bar back on the saw, turning it up the opposite way from the way it came off. This spreads wear evenly.
- Refit chain and tension it correctly.
- Clean and test the chain brake.
- Refuel the saw at the end of each day's use to minimise condensation in the fuel tank.
- Check high-tension lead.
- Drain and flush the oil and fuel tanks.
- Check the spark plug gap.
- Remove the starter cover and clean/check starter cord and pawls. Clean the cooling fins.
- Lubricate the clutch bearing if required.
- Check the fuel filter and clean/replace it as necessary.
- Dress the cutter bar and check the bar groove gauge.
- Clean the motor unit housing.
- Check/replace the screen in the muffler.

A suggested spare parts kit for your chainsaw

- A spare chain
- A spare bar
- Starter cord
- Starter spring
- Air and tank filters
- Spark plug
- Chain joiners
- Casing and cover screws

A suggested tool kit for your chainsaw

- The maker's tool kit supplied
- Grease gun (sprocket and clutch bearings)
- Calipers or crescent spanner (for checking cutter lengths)
- Feeler gauge (plug gap settings)
- Depth gauge jointing tool
- Flat file (guide bar dressing and depth gauge setting)
- Chainsaw file with a handle fitted
- Available filing aids and chain jointing tools
- Tuning screw driver
- Clean cloth
- Soft brush
- Chain guard
- Operator's Manual

Ladders

You should choose the type and length of ladder you use very carefully for each operation. Think about the heights you achieved on the previous lift and the new heights you will need to achieve on the current operation. This is very important when working in blocks that have previously been variable-lift pruned as the pruned heights will be different. Ladders that are too short will cause over-reaching and ladders that are too long may be placed in unstable positions and slip off the tree causing serious injuries.

The lean-to ladder

The ladder shall be specifically designed for commercial forestry. Where a lean-to ladder is used it shall:

- Have a working platform of at least 400mm wide by 200mm deep with a non-slip surface and have a “V” shape on one side, which will fit snugly against the tree trunk.
- Have points at the base of the stiles to improve stability in the ground.
- Have a chain located between the first and third rung from the top of the ladder which can be secured around the tree where stabilising is a problem.
- Have the serial number stamped on the ladder for audit purposes.



Chainsaw pruning from a step

Steps

A “step” is used to help operators achieve the required pruned height when their normal reach or the ladder length is not sufficient. If the pruned heights within a block are highly variable then it may be necessary to carry more than one step.

Steps vary in design but are generally held onto the tree by a chain. All steps must have their safe working load certified by the manufacturer, and be specifically designed for tree pruning. Steps must also have a serial number stamped on the step for audit purposes.

A big advantage of the step is that it eliminates the need for the operator to free climb into the branches or overreach. Operators must not leave the ladder or step and free climb into the branches to carry out pruning.

Maintenance of ladders and steps

It is important that operators carry out the following checks at least daily:

- Check the rungs and stiles for any cracks.
- Check the feet are in good condition.
- Check the top working platform is secure and free from defects.
- Check the chain and all attachments.
- Replace or repair the ladder immediately if any defects are found.

Ladder and step failures are two major causes of accidents in both manual and chainsaw pruning, so ladders and steps must be regularly inspected and maintained.

Epicormic remover

There are many types of epicormic remover. It is important that whatever type is used:

- It has a protective handle attached.
- The blades do not create a hazard for the worker when being carried or used.

Machetes or sharp knife blades can cause damage to the bark, and if used must be kept flat against the tree stem. Serrated or fine saw-edged blades are less likely to damage the tree.



Epicormic remover

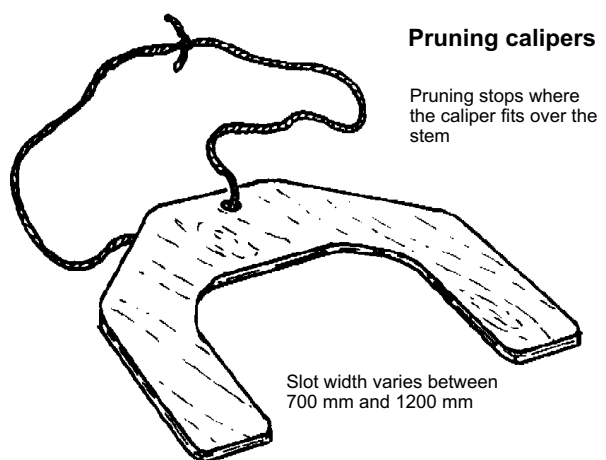
Gauges/Calipers

Gauges and calipers are used to measure branch and stem diameters.

Small gauges are used in some alternative species to measure branch sizes for removal during form pruning. For example a prescription might specify that all branches and leaders over 40mm in diameter be removed up to half tree height, plus the tree be pruned for clearwood up to 2.5 metres.

Many companies use larger gauges/calipers when prescriptions specify that trees are pruned until a DOS of "X" cm is reached. This method of pruning is common in many areas.

Some companies also use stem diameter as a measure to achieve the correct crown height. For example, in this block we know that if a tree is not pruned above the point where the stem diameter is 18 cm, then there will probably be 4 metres of green crown left.



Pruning calipers

Pruning stops where the caliper fits over the stem

Slot width varies between 700 mm and 1200 mm

Pruning caliper



Using the work positioning device, with both hands on the chainsaw

Fall protection device

Fall protection devices are worn to prevent the operator from falling to the ground if something goes wrong while they are pruning. They also have ergonomic benefits.

The most common causes of an operator falling are:

- Equipment breakage causing the operator to overbalance.
- Ladder slipping from the tree.
- Steps, grips and platforms detaching from the tree.
- Operator slipping off the ladder or step.
- Poor technique resulting in overbalancing.

Fall protection devices must comply with the requirements of AS/NZS 1891.4.

The fall protection device used in pruning operations is a **work positioning device** which is designed to secure the operator in the work position so that the job can be done, and reduces the risk of a fall injury.

Competency

When carrying out pruning from a ladder, the operator must wear a work positioning device once they reach 3 metres (the height of the operator's feet from the ground).

UNLESS:

The operator has demonstrated to their supervisor his/her competency to undertake pruning from a ladder (manual or chainsaw pruning).

Where the employer (or supervisor) has deemed an employee to be "competent", the employer shall maintain detailed documented evidence showing:

- The task the worker was carrying out.
- The situation the worker was carrying out the task in.
- Who deemed the worker competent and their qualifications and/or experience.
- How long the competency assessment took and when it was carried out.
- What visual demonstrations were observed to show competency, and
- The worker is working towards NZQA Unit Standards for:
either Chainsaw pruning units 6949, 6973, 6972
or Manual pruning units 6949, 1243, 1245
- Work positioning devices are used when the operator is in training and working with the feet 3 metres or more above ground, until competency is reached as described above.

Operators must use a work positioning device at all times when pruning with their feet 4.5 metres or more above the ground.

The lanyard part of the work positioning device shall be of metal or wire core construction.

Before choosing a work positioning device, check that:

- It is comfortable.
- It meets the Code of Practice requirements. (Refer to the Approved Code of Practice for Safety and Health in Forest Operations, Section 3, Topic 9).
- During operations using a work positioning device, check the device for wear or damage daily.

If in doubt contact your local OSH branch or Forest Owner for advice.

Fuel and oil containers

Fuel and oil must be carried in approved containers.

First aid equipment

The Approved Code of Practice for Safety and Health in Forest Operations outlines the following requirements for pruning operations.

- At least one member of each crew must hold a current first aid certificate issued by a recognised organisation at all times.
- A clearly marked first aid kit must be kept in each work vehicle and at each work area.
- Chainsaw pruning operators must carry at least two large sterile wound dressings protected from contamination on them at all times.

Ultra-high pruning

Ultra-high Pruning is defined as being pruning above the “normal” high pruning height of 5.8 to 6.5 metres. Although not specifically covered by the Approved Code of Practice, the requirements of the COP Part 3 Section 13, Silviculture, and accepted Industry Best Practice, have established some important criteria.

Ultra-high Pruning Equipment

Ladders

Ladders shall be of the lean-to type and comply with the New Zealand Standard 1892.1 1996 Portable Ladders: Part 1: Metal, and be of industrial rating with their working load certified by the manufacturer. As with other pruning ladders, they are required to have a working platform of at least 400mm wide and 200mm deep, with a “V” shape to fit against the tree. The feet of the stiles are pointed to increase stability in use.

Ladders used in ultra-high pruning must have the chain secured around the tree when the operator reaches the working height, and, must have a serial number stamped on them for audit purposes.



Ultra-high pruning

Work positioning devices

Operators working above a height of 4.5 metres (the height of the operators feet above the ground), are required to wear a work positioning device. For ultra-high pruning, the work positioning device must consist of a harness with a "D" ring on the chest for use in an emergency rescue.

The lanyard is required to be fastened around the tree when the operator reaches the working height, and remain attached around the tree during pruning.

Steps

Steps are used to reach branches beyond the operator's reach from the ladder, and are required to have their working load certified by the manufacturer, and be attached to the tree by a suitably rated chain.

The steps may vary in design, but are usually made of tubular aluminium with a platform for the pruner's feet, and designed to fit snugly to the tree stem.

Stirrups attached to steps require to be similarly rated and be checked for wear at each work break.

Personal Equipment

If using chainsaws, the ultra-high pruners need to carry and wear the standard equipment for chainsaw use. They need also to wear a purpose designed harness to carry tools, chainsaw fuel and water, and which can be utilised in an emergency to attach a rescue rope.



Training for Ultra-high Pruning

Pruners working on ultra-high operations require to have learnt their pruning techniques on other lower pruning operations and, to graduate to ultra-high, they need to train in the use of work positioning devices, and in techniques for the rescue of another ultra-high pruner who may become disabled while up a tree. For this purpose the pruning crew need to have rescue equipment available on the job at very short notice.

Crew members require to be in sight or voice contact during the operation, although the distance may vary according to the terrain and vegetation.

Maintenance of manual pruning equipment

Regular maintenance will ensure maximum safety and efficiency.

It is recommended that the following accessories be kept on the job:

- Two adjustable spanners
- Flat screwdriver (for star-washer tabs)
- Jacksaw blades
- Pruner bolts, handles, nuts, and washers (high strength steel only)
- Nails (for jacksaw blades)
- Medium grade water or oilstone (to maintain the edge on pruner blades)
- Oil for pruners
- Spare ladder

If the operator is working where there is no access for his vehicle, some of these accessories will need to be carried onto the worksite.

How to prepare for pruning

Training and supervision

Nearly half of all silvicultural accidents happen during manual pruning. The main types of injuries are:

- Sprains/strains
- Lacerations (cuts)
- Bruises
- Abrasions (grazes)

Chainsaw pruning is generally more hazardous than manual pruning but is not as common. The most common injuries in chainsaw pruning are:

- Sprains/strains
- Lacerations (cuts)
- Dislocations

Accidents can lead to the operator losing income because he is disabled. They also lead to cost increases for the employer when accident insurance levies are increased. This may lead to loss of jobs and contracts.



Close supervision and correct training are essential until new workers can prove they can work safely.

The Approved Code of Practice for Safety and Health in Forest Operations requires that:

Before any worker begins pruning, the employer must place them under the close (constant and one on one) supervision of a competent person. That person must continue to supervise the worker until they are sure the worker can prune safely and is not likely to harm themselves or anyone else.

The employer must also make sure the worker receives enough training to be able to carry out the job safely.

Extra attention must be given to the training and supervision of new or inexperienced operators as most serious injuries happen to operators who have less than 6 months' experience.

It is recommended that no operator carries out chainsaw pruning up ladders unless he/she is experienced in chainsaw pruning from the ground and manual pruning from a ladder.

All operators must be under or have completed a documented training programme and should be aiming to pass or have passed the relevant NZQA Units that make up the FIRS modules 2.4 Silvicultural Pruning and, if applicable, the units making up FIRS module 2.8 Chainsaw Pruning.

Knowledge of hazards

As part of the supervision and training programme, operators need to be **shown** the hazards they will face on the job. They must also be familiar with the controls to avoid being harmed by those hazards.

Before starting any new block all operators must be involved in identifying any significant hazards **on the site** and the way those hazards will be controlled. There must be documented evidence on site listing the hazards and controls and showing that all operators have been made aware of those hazards and controls.

Listed below are some hazards that have contributed to serious pruning accidents in the past. All operators should be familiar with these hazards.

Health hazards

Pruning is a very physically demanding job. Studies have shown that operators work as hard as a marathon runner or cyclist.

To maintain peak performance and prevent accidents through fatigue, operators must take special care of their bodies including their physical fitness, diet, water intake, personal hygiene and sleep. Each operator must also take special care of his body while away from work.

Health hazards

Hazard	Control
Lack of rest/sleep	<ul style="list-style-type: none"> • Build short frequent rest breaks into your work routine. • Take at least two evenly spaced 30 minute rest breaks during the working day.
Early starts	<ul style="list-style-type: none"> • Ensure each night you replace the sleep you lose in the morning. If you get up earlier go to bed earlier. • Once early starts have finished, allow time for your body to recover.
Alcohol abuse	<ul style="list-style-type: none"> • Avoid drinking alcohol for at least 24 hours before carrying out any hard physical work.
Lack of nutrition <i>(most accidents occur between 9 and 11am when you are tired and running low on energy, so stop and have a smoko break)</i>	<ul style="list-style-type: none"> • Start each day with a high carbohydrate breakfast like porridge, cereal, toast, bananas, pasta, or potatoes. • Eat high protein foods like lean meat, chicken, eggs, milk, and cheese at night. • Eat at the start of a break and rest to allow digestion. • Always eat a high carbohydrate snack straight after work.
Drugs	<ul style="list-style-type: none"> • Avoid all non-prescription drugs as they seriously affect both your mental and your physical ability to work. • Inform the boss if you are on any medication that may affect your work. Stay home if necessary. • Before receiving any medication, tell your doctor what you do for a living. • If you are on long-term medication for a serious health complaint, inform the boss or crew of your condition in case you are involved in an emergency at work.
Exposure to sun	<ul style="list-style-type: none"> • Wear sun block • Wear light shirts on hot days • Wear a hat • Carry out regular health checks

Health hazards (cont . . .)

Hazard	Control
Over-exertion/sprains and strains	<ul style="list-style-type: none"> • Start each day with a 10-15 minute warm-up (slow pruning) and then a few stretches • Start the day slowly until muscles are warmed up properly • If starting a new job, allow time for the body to get used to it before working flat out • Do some stretches at the end of the day • Take particular care when starting back at work after the holidays
Hypothermia/chills	<ul style="list-style-type: none"> • Polypropylene clothing (thermal underwear) is excellent for cold wet weather • If necessary also wear a warm hat, rainwear or chaps • Put a hat and warm clothes on when you stop for a break • Bring spare dry clothing even on fine days. The weather can turn bad very quickly
Lack of hygiene/infection	<ul style="list-style-type: none"> • Clean and dress any cuts or scratches as soon as possible and keep them covered • Make sure the first aid kit is kept fully stocked • Carry water and soap on the job to wash your hands before smokes • Bath or shower every night • Eat a balanced diet to keep your body healthy • Wear clean clothes against the skin every day
RSI (OOS)	<ul style="list-style-type: none"> • Use correct techniques — roll pruners rather than use brute force • Good tool maintenance • Regular medical examinations • Use pre-work warm up and stretching techniques throughout the day • Wear gloves to reduce jarring through the wrists

Health hazards (cont . . .)

Hazard	Control
Dehydration/heat exhaustion	<ul style="list-style-type: none">• Regularly drink fluids (water or preferably Powerade, Gatorade, Refresh, “Active”, etc.) at a rate of 0.5 litres per hour and up to 1 litre per hour in hot conditions• Drink before you feel thirsty• Do not drink fluids like soft drinks and cordials, that have more than 8% sugar content• Drink high carbohydrate drinks after work to replace energy levels• Drink plenty of water at night to recharge the body• Drink a couple of glasses of water before leaving for work

Operational hazards

Hazard	Control
Ineffective personal protective equipment	<ul style="list-style-type: none">• Don't perform the pruning tasks with ineffective protective equipment• Replace any worn, damaged or expired protective equipment• Routinely check the condition of your protective equipment
Jacksaws	<ul style="list-style-type: none">• Always carry your jacksaw in a pouch when it is not in use• Always keep your free hand above the jacksaw when you are pruning branches• Place a supporting hand on the tree when using your jacksaw
Pruning shears	<ul style="list-style-type: none">• Carry pruners in a pouch at all times when you are not actually working with them• Pick up your pruners from the handle end, not by the blade• Use the correct technique when sharpening blades
Bolts breaking in pruning shears during pruning	<ul style="list-style-type: none">• Attend to good maintenance of pruners• Ensure correct bolts are used
Footing	<ul style="list-style-type: none">• Watch your footing when walking between trees and standing on ladders. Pay particular attention to wet logs and slash in old cut over areas• You should avoid jumping from any ladder• Boots must provide good ankle support and good grip
Ladder positioning	<ul style="list-style-type: none">• The ladder should be placed on the uphill side of the tree• Ensure the ladder is at a safe angle to the tree• All ladders shall have spiked feet that are secured into the ground before climbing• Position the ladder so you are in the best position to remove the worst branch

Operational hazards (cont . . .)

Hazard	Control
Epicormic knives	<ul style="list-style-type: none"> • Always carry your knife in a pouch when it is not in use • When cleaning epicormics from the stem, keep your free hand clear of the blade
Starting chainsaws	<ul style="list-style-type: none"> • If starting cold, place the saw on the ground, have your left arm straight and in a mitt, put your right foot in the rear handle or put your knee on the handle • If starting warm, use step over method of starting • If you are starting your chainsaw while you are up a tree, ensure the saw is warmed up, then support the chainsaw on a branch or positioned on the other side of the tree before starting up
Falling branches	<ul style="list-style-type: none"> • Position your body so falling branches do not hit you • Place the ladder in a position that avoids having your body under large branches • Wear a helmet
Carrying chainsaws	<ul style="list-style-type: none"> • Turn the saw off or activate the chainbrake when walking any distance or over obstacles • Place the chainsaw on your belt.
One-handed chainsaw use	<ul style="list-style-type: none"> • Hold on to the tree with your free hand • Keep your free hand on the opposite side of the tree to the chain or above the chain
Kickback	<ul style="list-style-type: none"> • A suitable cutter bar guard must be fitted • Do not use the upper tip of the bar • Ensure the chain brake is working

Operational hazards (cont . . .)

Hazard	Control
Operators falling off or slipping from their ladder/step as they climb, descend or prune	<ul style="list-style-type: none">• When climbing or descending, put the pruners in a pouch. Move one rung at a time and grip the ladder with two hands. This eliminates the chance of operators cutting themselves going up and down the ladder as the pruners must be in their pouch• Gloves should be worn on pruning operations — they help to prevent falls (by improving your grip on the pruners)• Set the ladder firmly against the tree before climbing and always on the uphill side of the tree• The top platform should have a non-slip surface (see page 8)• Ladders should have chains to secure them to the tree at about the second to third rung from the top• Ladders must be well maintained with no loose or damaged rungs or cracks in the stiles• Jumping from ladders should be avoided• Do not overreach when working from a ladder• All ladders must have spiked feet that are set in the ground before climbing• Provide a fall protection device for those operators who request one, and for people in training• Use a fall protection device suitable for the task according to the Approved Code of Practice for Safety and Health in Forest Operations• When using a fall protection device in chainsaw pruning ensure the lanyard is of wire core or chain construction

Tree selection

Tree selection is the process of choosing which trees are suitable crop trees within a plantation forest. This happens prior to or during a tending or thinning operation. Tree selection improves the quality of the stand by choosing trees with superior growth, form, and health. This creates a stand with more uniformity and greater value and financial return to the forest owner.

All pruning operators must have knowledge of tree selection and be able to interpret the selection requirements from the job prescription.

In all pruning, before the operator moves to the NEXT TREE to be pruned he or she should:

- Consider its suitability for pruning
- Estimate the prune height
- Determine the most efficient and safe route to the tree

Before the tree is pruned, it must be re-checked to confirm that it is suitable for pruning. This will avoid wasted time and energy.

Basic criteria for tree selection

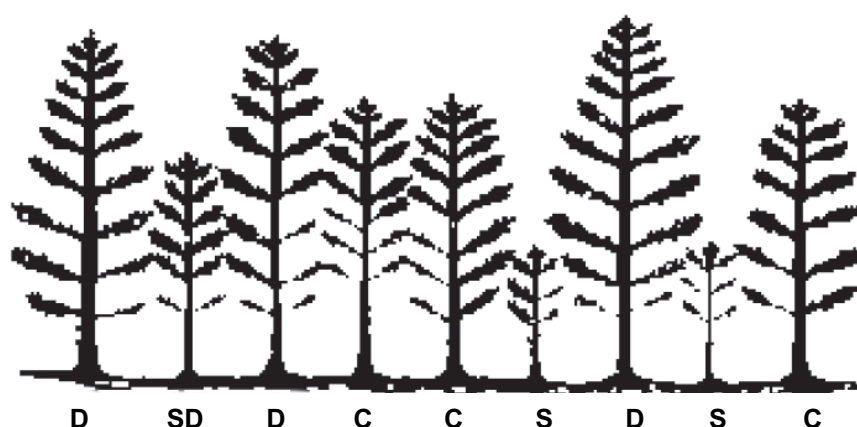
The following three criteria are the most important when carrying out tree selection.

- Dominance and tree health
- Form
- Stocking and spacing

Dominance and tree health

Dominance and tree health is assessed by visually comparing the tree with surrounding trees. Factors to consider are: tree height, crown width and depth, diameter at breast height, and healthy appearance (e.g. foliage colour, needle length, and foliage density). All crop trees should be either Dominant or Co-dominant. Sub-dominant trees are acceptable if there is no other option.

Nutrient deficiencies, disease, insect attack, animal attack, deep wood damage, bark damage, oversize branching, excessive DOS, and excessive resin bleeding are all undesirable features. These faults may lead to dominant trees being rejected if they are too severe.



D = Dominant C = Co-dominant SD = Sub-dominant S = Suppressed

Relative tree dominance (derived from NZ Forest Service Tree Selection Guidelines)

Dominants	Tallest trees Above average crown size Above average DBH
Co-dominants	Average height but not as tall as dominants Crowns shorter and narrower than dominants Average DBH
Sub-dominants	Markedly shorter than co-dominants Crowns shorter and narrower than co-dominants Below average diameter
Suppressed	The smaller trees in the stand Crowns almost overgrown by the crowns of surrounding trees Well below average diameter Growth rate very poor

Form

Stem form

The straightness of a tree, especially the first 4.5 metres, is critical in determining the value of the tree in the future. The following specifications are guides only and may vary depending on the requirements of the forest owner.

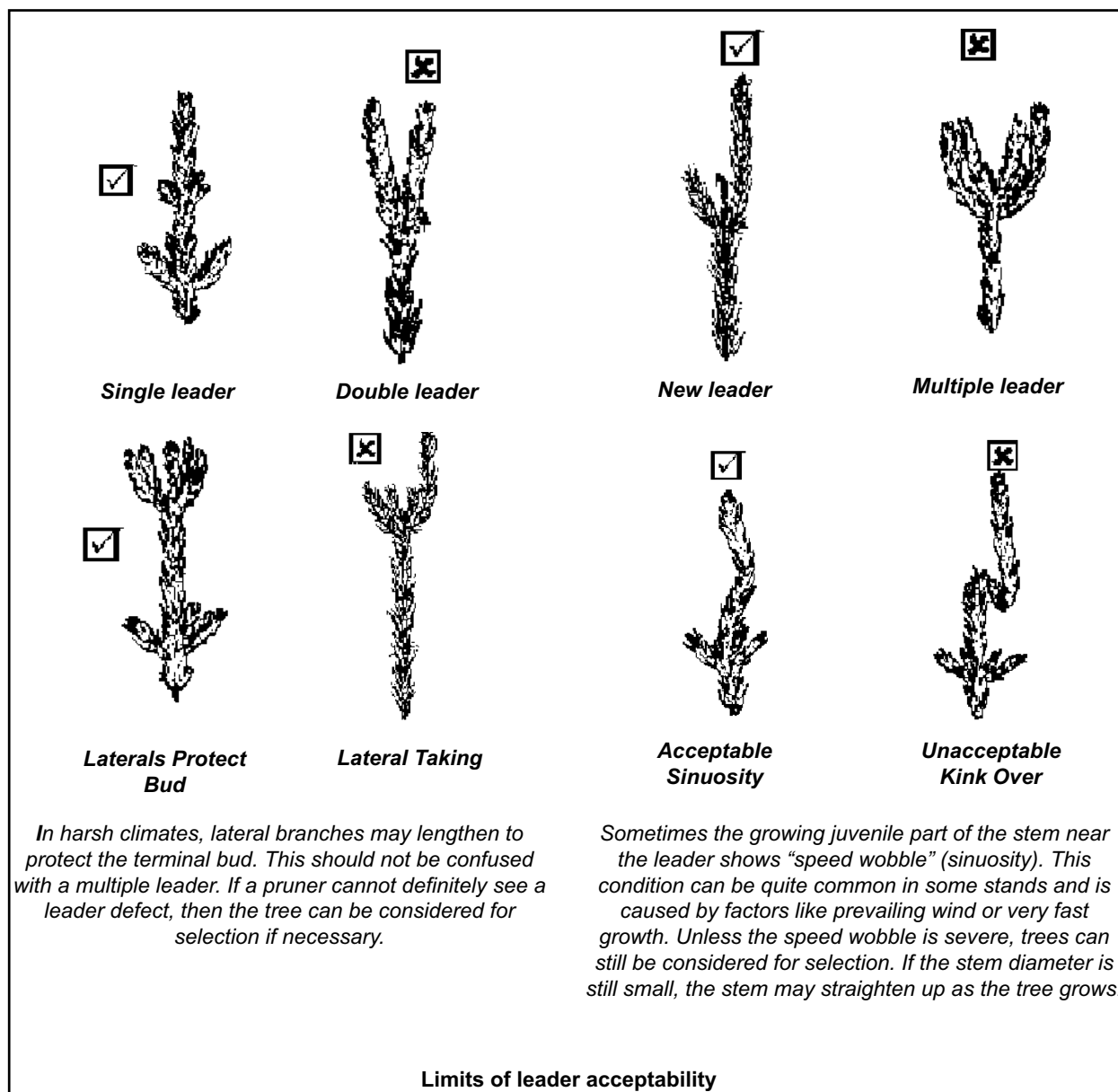
For butt swept trees, the first 0.4 m will end up being part of the stump. If a tree has butt sweep above 0.4 m, then an imaginary line from the top of the pruned stem to 0.4 m above the ground should stay within the stem just like the requirements for sweep and kink.

It is better if all trees selected are standing straight up and down (vertical). If an imaginary vertical line is drawn from beside the base of the tree upwards and the line is more than 10 cm away from the stem at 1.4 m, then the tree is generally unacceptable.

Ideal trees should have no stem sweep, wobble, or kink but an inferior tree may be selected to achieve the correct stocking. Generally, a tree is acceptable if an imaginary line from the top to the bottom stays within the stem.

Leader condition

"Leader" refers to the top 2 metres of the tree. Trees with double leaders, multiple leaders, dead, diseased, or missing leaders are all unacceptable as crop trees but may be chosen as a last resort to achieve the correct stocking. Sometimes it is possible to remove a small leader or ramicorn branch to bring these trees within acceptable limits.



Branch habit

The sizes, habit, and number of branches all affect the final log quality. Smaller branches occlude more quickly when removed. Very large branches, steep or vertical angled branches (ramicorns), and "basket" whorls are all undesirable, but acceptable when there is no other choice.

If a badly formed, heavily limbed, dominant tree known as a "wolf tree" forms, and it is competing with a well-formed dominant tree, it should become a cull.

Stocking and spacing

The stocking and spacing of trees will affect branching and tree size. High stocking rates can produce tall straight trees with smaller branches in the upper logs. High stocking often provides a higher total volume at harvest, an important factor if the crop is designated a “pulp crop”. Other benefits of high stocking may include less risk of wind snap, less weed competition, and a slightly higher wood density.

In contrast, lower stocking rates can result in fatter trees, but with larger branches in the upper logs. Even spacing throughout a stand is essential to produce optimum volume and value.

Thinning operations during the rotation are used to manage tree branching and tree size to provide the maximum returns to the forest owner.

Stocking is normally stated as the number of stems per hectare. Most prescriptions will give operators the following information:

- Current overall stocking
- Current pruned stocking (if applicable)
- Target or crop stocking for the operation plus a minimum and maximum stocking
- Minimum spacing between trees

Operators can use the stocking information on the prescription to help them in their tree selection - e.g. if there are 800 stems per hectare currently planted and the forest owner wants 400 stems per hectare pruned, the operator must prune one tree in two.

Tree to tree spacing is determined by the prescribed stocking and is usually written on the job prescription. If it isn't, the spacing can be worked out using the prescribed stocking - e.g. if the prescribed stocking is 500 stems per hectare, all trees should be around 4 to 5 metres apart.

Quality

The job prescription

A job prescription is a written instruction from the forest owner detailing his requirements for the pruning operation. It may include:

- Height of lift
- Crown depth
- Pruning method
- Selection and stocking requirements
- Quality requirements
- Environmental considerations
- Map of area showing boundaries and contours
- Previous stand history
- Safety requirements including a list of hazards identified by the forest owner or their representative.

It is important that all crew members have been briefed on the content of the job prescription and if possible have a copy.

No job prescription or an inadequate job prescription may result in poor pruning quality and conflict over the actual standards required which could lead to:

- The individual operator's and the crew's daily tally may be reduced. This will result in less income
- The employer may suffer penalties and damage his relationship with the forest manager
- The forest owner may end up with a lower value forest, re-assessment costs, and extra supervision costs
- Costly re-working of an area



Using a measuring pole one person should sample the heights of all pruning particularly at the start of the block.

Method of gauging the correct pruned height before starting a block.

Pruning faults

Pruning faults may impact on the value of individual trees and on the value of the crop. The main types of faults that occur are as follows.

Height assessment faults, including;

- over pruning
- under pruning

Branch removal faults, including;

- coathangers
- collar damage
- epicormics
- branches remaining
- bark damage

Stocking and spacing faults, including;

- pruning too many trees or too few trees
- poor tree selection
- uneven spacing

Height assessment faults

Pruning to the correct height is crucial.

Over pruning (pruning too high or “scalping”) can lead to the following problems.

- Slow tree growth - removing too much foliage reduces the tree’s capacity for photosynthesis. This results in slow growth.
- Death of the tree - removing too much foliage stresses the tree and makes it vulnerable to drought, disease and insect attack.
- Loss of production - every branch or whorl that is removed unnecessarily (i.e., above the required prune height) reduces the number of trees-pruned-per-day (production) of the operator.

If trees are **under pruned** (pruned too low) then the target DOS will not be achieved. This will result in a larger defect core and a lower pruned log value. It is important that operators understand the heights they are required to achieve before they begin each block, and that they can maintain those heights throughout the block.

The number of whorls to be removed and the **correct pruned height** of any tree should be assessed during selection and before pruning begins. If the operator is up a ladder and unsure of the correct height, he should ask nearby workmates or the foreman to help decide whether the correct pruned height has been reached. Always measure pruned heights from the uphill side of the tree.

Branch removal faults

Coathangers (*right*) are a common pruning fault. They increase the size of the defect core inside the tree and decrease the clearwood. This lowers the tree's value.



Coathangers

Collar damage, like that shown at right by the resin bleeding above the branch stub, increases the time needed for the branch stub to occlude (grow over). In severe cases this can lead to major defects in the stem and resulting timber.



Collar Damage

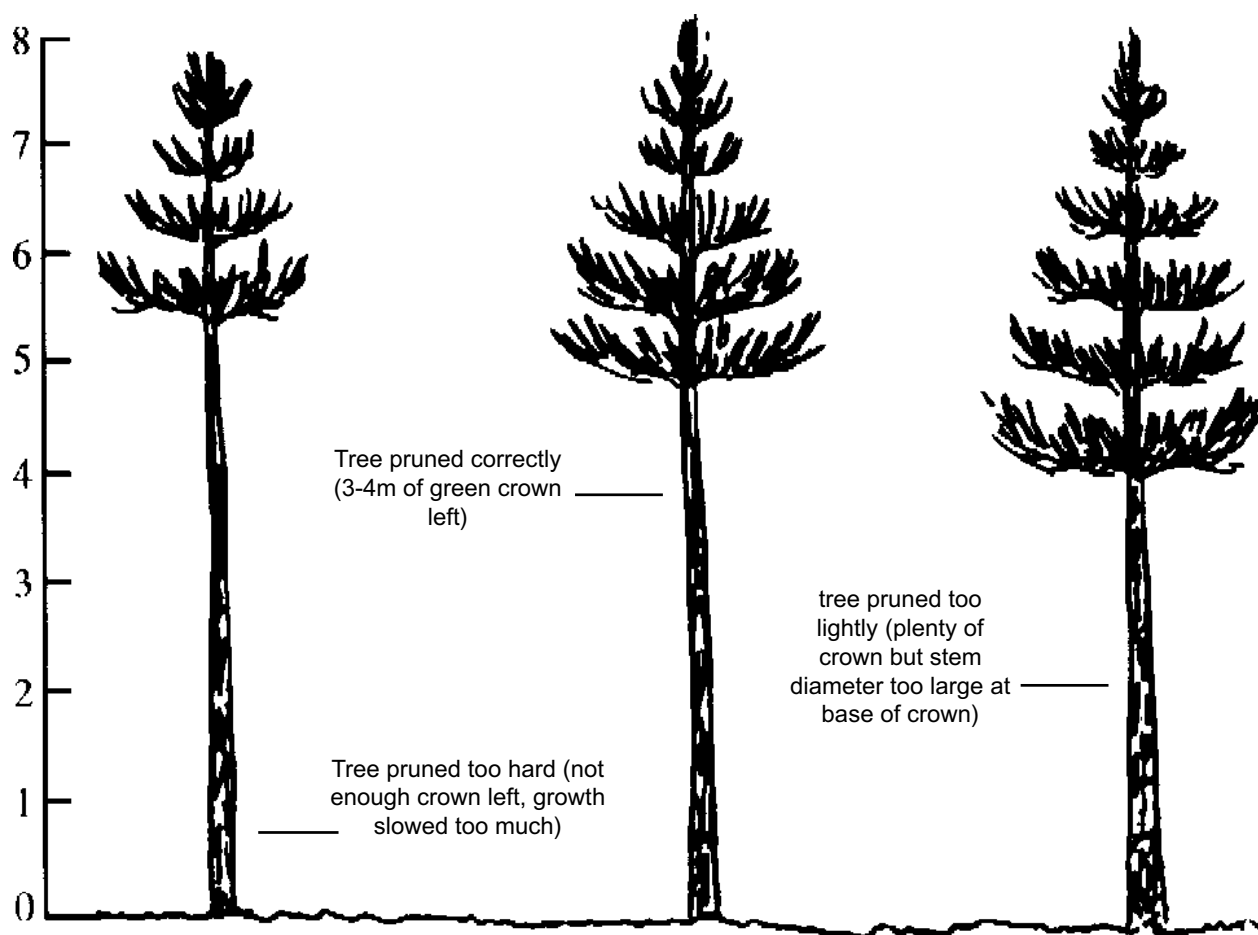
Epicormic shoots are needles that grow on the stem of radiata pine. They often develop into small branches. If left in place on trees in sunny positions, these shoots will continue to grow between pruning lifts. This can reduce the amount of clearwood in a pruned butt log.



Epicormic Shoots

Branches remaining below the target prune height will reduce the value of a pruned butt log. Even if pruned during the next lift, the depth of clearwood will be much less than it should have been. Branches may be missed during a lift because they were obscured by ground vegetation.

Bark damage either on the whorl or between whorls will result in a wound that will be slow to heal. This may result in unnecessary stress on the tree affecting its vigour.



Correct and incorrect pruning of an 8-m tree. Only the middle tree has been pruned correctly

Stocking and spacing faults

Pruning too many trees is expensive and inefficient for the pruning contractor as they are paid on the area pruned not the number of trees.

Pruning too few trees will reduce the potential value of a crop by promoting butt logs with large defect cores. From the contractors' point-of-view, the forest owner may impose a penalty on them for not meeting the requirements of the prescription.

Despite pruning the right number of trees, poor tree selection can dramatically reduce the value of a crop. Pruning malformed or less vigorous trees is expensive and will not result in a high quality crop. Even if pruned these trees may end up as pulp, or lower grade timber products.

Silvicultural pruning procedures

Recommended branch cutting technique for loppers/pruners

Many operators tend to use brute force rather than technique to remove branches when pruning. This often leads to strain/sprain injuries and, as the muscles are under constant tension, OOS injuries can occur in the shoulders, arms and wrists.

By using the technique shown here, branches can be removed with very little effort. The arms are relaxed and the pruners are rolled around the branch in a 3 step action making the blades slice through the wood in a sawing action which causes less resistance.

Removing large branches with loppers

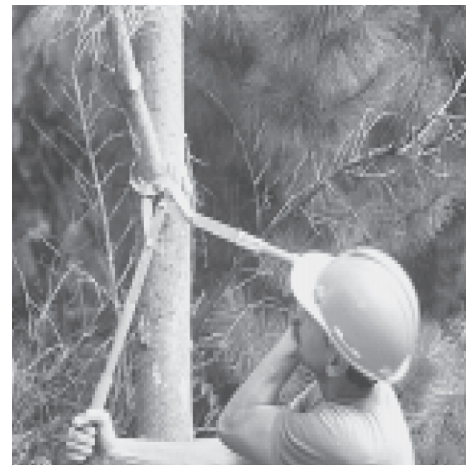
Many injuries have occurred while operators have been cutting large branches with pruners/loppers. Most injuries are strains and sprains caused by:

- Using an incorrect technique
- The body being in an awkward position
- Fall injuries caused by operators losing their balance on ladders.

It is recommended that operators carry jacksaws to remove any large branches. If no jacksaw is available it is possible to remove large branches by using the following scarfing technique. (Next page).



Place the blade against the tree and squeeze the blade into the branch.



Applying firm pressure, push the pruners away from you.



Applying firm pressure, pull the pruners back towards you and roll the blade over the top of the branch until the branch is removed.

Branch cutting technique



With the blade flush with the collar, cut halfway through the branch.



Make a parallel cut above the first cut.



Remove the cut section with the pruners leaving a scarf in the branch.



Place the pruners inside the scarf. The blades should now fit around the remaining piece of branch stem.

Removing large branches with loppers

Removing large branches with the chainsaw

Removing large branches with a chainsaw can also be very hazardous, particularly when the operator is up a ladder. Large branches can also tear strips of bark off the tree as they fall if they are not cut correctly.

All large branches should be double cut and the remaining coathanger cut flush with the branch collar.

Pruning From The Ground

Step 1

Remove the branches that hinder access to the stem.
Re-check the selection.



Step 2

Remove the lower branches while in a kneeling position. This reduces the chance of injury to the back.





Step 3

Remove branches up to the correct height then prune from top to bottom while moving around the tree in a clockwise direction (where possible). It should be necessary to move around the tree once only.



Step 4

Check that the tree has been completely pruned.

Remove epicormics and ramicorns (pay particular attention to the base of the tree).

Select the next tree.

Manual pruning from a ladder

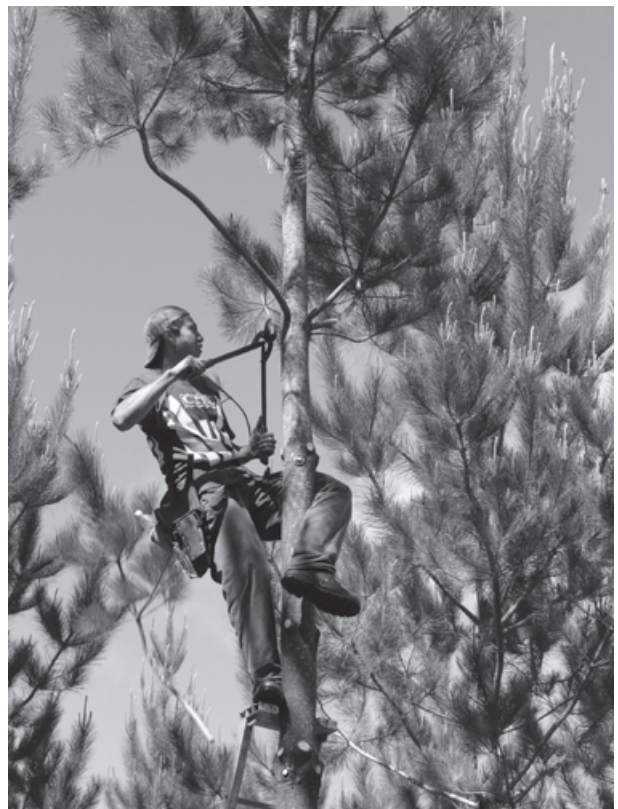
Step 1

- Check for any overhead hazards.
- Place the ladder against the uphill side of the tree to get the best stability (so you don't need to overreach).
- If possible place your ladder or "step" to give good body position for the largest or most difficult branch.
- For lower lifts the ladder feet should be at least half a metre from the tree. For higher lifts the ladder will need to be further out. The photos give an idea of the correct ladder angle. (Approximately 15 degrees from vertical)
- Set the ladder feet firmly in the ground.
- Make sure the top is secure against the tree.
- Climb the ladder using both hands (tools are to be kept in a pouch so hands are free for climbing).
- Secure chain around the tree if fitted.
- Maintain a safe distance from your workmates (two ladder lengths is recommended).



Step 2

- Use a systematic pruning technique.
- Hook a leg around the back of the tree for extra support once the last two or three rungs have been reached.
- When you are in training use a work positioning device if both feet are over 3 metres above the ground.
- Watch for falling branches.
- Do not overreach.





Step 3

- When pruning is completed remove epicormics.
- Check quality and height.



Step 4

- Select the next tree to be pruned.
- Climb down rung by rung with hands free and tools in pouch.
- Do not slide down the ladder or jump from the ladder.
- Do not carry the ladder in any way that may injure you if you fall.
- Avoid damaging the ladder when moving between trees.

Chainsaw pruning from a Ladder

Step 1

- Select the correct tree.
- Check for overhead hazards.
- Place ladder on the uphill side of the tree.
- Ensure that both ladder feet are firmly in the ground.
- Start your chainsaw using either a conventional cold or warm start.
- Apply the chainbrake and place the chainsaw on the belt.
- Climb the ladder using both hands and place both feet on the same rung when you reach the operating position.
- If you are in training or your feet are more than 4.5 metres from the ground, secure the lanyard around the tree.
- Place your knees in against the next ladder rung.
- Open up the first whorl by cutting branches that hinder access.
- Using two hands, cut branches on the left side to open the whorl.
- Work anti-clockwise cutting branches on the right hand side.
- Cut the rear and difficult left hand branches last.
- If you need to use the saw one-handed then the stem must be between you and the bar and your free hand must be on the opposite side of the stem to the bar.



If your saw is cold, start it on the ground, warm it up, and either apply the chainbrake and proceed as above, or stop it and climb to your pruning working position. If you are starting your chainsaw while you are up a tree, support the chainsaw on a branch or position it on the other side of the tree before starting up.



Step 2

- Remove remaining whorls using a similar cutting pattern to the first whorl.
- Cut heavy branches 30 to 50 cm away from the stem and then cut off the stub flush with the branch collar. This will allow the branch to fall safely away and also prevent scarring the tree due to slabbing.



Step 3

- Check all whorls for coathangers.
- Switch off the chainsaw.
- Place the chainsaw on your belt.
- Check for and remove epicormics.
- Climb down the ladder using both hands to hold the stiles.

Glossary of terms

Branch collar	A swelling where the branch leaves the tree stem.
Canopy	The combined upper foliage of trees.
Clearwood	Wood that is free of knots.
Coathangers	Stubs left when the branch is not cut flush with the branch collar.
Crop trees	Trees that are managed with the intention of taking them through to harvesting.
Cross over	When the pruner hook and cutter cross over each other. Severe damage occurs to the working edges due to a loose centre bolt or to the worker twisting the handles while cutting the branch (incorrect technique).
Crown	Upper foliage of a tree.
DBH	Abbreviation for diameter at breast height, 1.4 m from the ground.
Dehydration	Occurs when the body has not replaced the fluid it has lost through sweating and breathing. Dehydration will lead to a loss of energy and concentration and possible loss of balance.
Diameter	The width of a tree at any given height.
Dominant tree	A tree with above average height, diameter, and crown size.
DOS	Diameter over stubs. The whorl with the largest diameter within the lift will be the DOS whorl. DOS measures the defect core of the tree.
<i>Dothistroma pini</i>	A fungus that attacks the lower branches of pine trees and causes the needles to die. If not treated it will retard the tree's growth or kill the tree.
Epicormics	Small branch-like shoots that grow on the stem of a tree and if not removed will cause defects in clearwood.
Fall protection device	Includes safety belt, harness and lanyard.
Feather edging	A rough weak edge that may be left after sharpening only one side of a cutter.
Feathering	A stub defect where a loose pruner centre bolt or excessive blade wear causes incomplete cutting of the branch.
Final crop trees	Trees that remain after all silvicultural operations are completed.
Fixed lift	Pruned height is similar for all trees regardless of the height or diameter of individual trees.
Form pruning	Removing competing leaders and large branches to improve tree form.
Gauge	A caliper tool used to estimate pruning height at target DOS.
Gauge pruning	A method of determining the pruned height of a tree by measuring stem diameter. When the caliper-type gauge fits the stem, that is the top of the lift.
Internode	The length of stem between whorls of branches.
Kink	A sharp change of angle of a log or tree.
Malformed	Any tree that has a defect which is unacceptable for the operation being carried out, e.g. kink, wobble.
Occlusion	The branch collar growing over the branch stub to heal the wound.
Over pruned	A tree that has had too much foliage removed. Over pruning will slow the tree's growth or in some cases may kill the tree.
Overreaching	Happens when the ladder is too short. The worker will stretch to prune branches and risk falling or strain injuries.

Glossary of terms (cont ...)

Occlusion	The branch collar growing over the branch stub to heal the wound.
Over pruned	A tree that has had too much foliage removed. Over pruning will slow the tree's growth or in some cases may kill the tree.
Overreaching	Happens when the ladder is too short. The worker will stretch to prune branches and risk falling or strain injuries.
Pruning gauge	A gauge used to establish pruned height from stem diameter.
Ramicorn	A large high-angled branch that often occurs when one leader of a fork is suppressed by another.
Silviculture	Forest operations that improve the trees' growth and value — fertilising, tree releasing, pruning, and thinning.
Stems per hectare	The number of live trees per hectare, commonly known as “stocking”.
Stocking	Refers to the number of trees on an area at any given time, expressed in stems per hectare.
Suppression	At high stockings and/or advanced stand ages, weak trees will fail to obtain enough light, water, or nutrients. This will reduce growth and may result in death of the tree.
Sweep	A gradual bend in a log or tree.
Ultra-high pruning	Pruning above the “normal” high pruning height of 6.0 to 6.5 metres.
Variable lift pruning	Pruned height is allowed to vary with the height of individual trees.
Vigour	The ability of a tree to grow in size. At a given age, trees with the greatest vigour will be larger in diameter and height.
Whorl	A number of branches around the stem of a tree at the same level.
Wobble	A deviation which affects only a short length of log or tree.
Work positioning device	A device designed to secure the pruner in the work position while pruning.

Index to unit standards

The following provides an index to NZQA Unit Standards directly linked to the content of these Best Practice Guidelines.

Unit

6949	Demonstrate Knowledge of Pruning Plantation Trees
6951	Demonstrate Knowledge of Selecting Plantation Trees
1243	Prune Plantation Trees from the Ground
1245	Prune Plantation Trees from off the Ground
6973	Prune Plantation Trees with a Chainsaw from the Ground
6972	Prune Plantation Trees with a Chainsaw from off the Ground

Poroporoaki

Whaia te huarahi
o te mātauranga

*Pursue the path
of learning.*

Ka piki ake koe,
ka whānui atu nga pae.

*The higher you climb,
the wider the horizons.*

Rapuhia nga pae
i roto, i tōu nei ngakau.

*Seek also the horizons
within your self.*

E tipu, e awhi, e tū.

Grow, embrace, stand tall.

Vision, knowledge, performance