Training Module
Reduced Impact Logging
Controlled Felling Techniques

Integral Module
The application of Reduced Impact Logging (RIL) techniques is one of the important requirements for the certification of sustainable forest management. However, considerable effort still has to be taken before the RIL practises will be operational on a large scale in the region.

Previous experiences have already demonstrated the necessity and feasibility of the training in Reduced Impact Logging (RIL) techniques in the Congo Basin.

Notwithstanding the considerable differences between the different countries of the Congo Basin we are of the opinion that by introducing the RIL practices in Gabon we can investigate at first hand the impacts of the conventional logging and demonstrate the advantages of RIL techniques for the enterprise and for the environment of all of central Africa.

This because Gabon still accommodates a rich and very much varied patrimony of fauna and flora, which is not only like elsewhere, seriously threatened by the logging and mining industries and by the progressing demography, but also still very much susceptible to methods that might avert these threats.

As the logging techniques in tropical countries can differ from country to country, and even from region to region and all the more as there are not yet sufficient data on RIL in Africa available, it is still difficult to convince foresters of the advantages of the application of RIL.

The RIL training courses aim at teaching logging staff and workers these specific techniques and to optimize their skills.

The following modules have been composed to create a package of instruction covering most of the aspects of logging techniques under RIL methodology:

- Cartography
- Forest inventory
- Road planning
- Road construction
- Controlled felling
- Planning of skid tracks and tracing
- Planned extraction
- Log landing operations
- Post-harvest operations
- First aid in the forest
- Operational management in RIL
ACKNOWLEDGEMENT

This task could never have been accomplished without the generous support of the persons mentioned hereunder.

Our first concern was the accommodation of the project with a logging company that was already well ahead on the way to sustainable forest management.

We found the directorate of the Société des Bois de Lastourville (SBL), in the persons of Messrs. Pierre et Stéphan Vergnaud, willing to lodge us and to assist us with all their facilities, their equipment and their work force. SBL is already well advanced on the way to certification of sustainable forest management and its concession has ideally helped us as experimenting field. Furthermore, the forest put aside for us by SBL is perfectly suitable for the execution of the training. We owe Pierre and Stéphan Vergnaud a great debt of gratitude.

I am also very grateful to Mr. Frank Stenmanns, sustainability manager of SBL, for his patience, his collaboration and his tireless assistance, that he give me aside from his daily tasks, with the preparation of the compartments for the project, the discussions on the inventory, the mapping and the road planning.

A great many thanks also to the management of the company CEB-Thanry à Bambidie, Messrs. Jean-Marie Pasquier et Philippe Jeanmart, the real pioneers of RIL in Gabon, for their hospitality, their advising and their very valuable ideas about subjects such as cartography, construction of roads and bridges and extraction techniques. The exchanges of experiences often took place during delicious lunches at the swimming pool in Bambidié, but were nevertheless very instructive for me.

The editing of the modules by Dr. Peter van der Hout, founder of the RIL training centre of TFF in Guyana and his incomparable knowledge of RIL have guarded me from too many blunders. Moreover, his visit to Lastourville was very pleasant and far too short.

Hattem, the Netherlands, July 2010

Mans Vroom
1. INTRODUCTION

After all preparatory activities, felling of the trees is the initial operation of the logging.

The fast cutting of the wood with the chainsaw increases considerably the dangers for the operator and other peoples present in comparison with felling by axe. Indeed, the moment of the fall approaches much quicker et less visible because of the noise of the chainsaw that can muffle the first cracks of the woodfiber announcing the coming fall. Controlled felling techniques exists to able the feller to decide exactly the moment of fall and so to take security measurements in time.

The more, the damage to the residual forest and even to the tree trunk can be influenced by a minor change in the direction of the fall and by a correct application of the cuts of the chainsaw.

Most of the fellers have been trained as assistant by their former feller and have naturally taken over the techniques of this feller, including the bad habits.

The controled felling techniques have been developped as training module that has proved to give a very high security level and a considerably increased yield of the wood by reducing splitting, ringshakes and ripping.

The controlled felling training has a more practical than technical character: the felling techniques, sharpening of the chain and maintenance of the chainsaw are not only described in the integral module, but also treated in a very detailed way in the operator's manual.

We especially thank the Andreas STIHL, the manufacturer of chainsaws for their very generous attribution of highly modern chainsaws and security and instruction materials.
2. OBJECTIVES

The controled felling training covers four important RIL objectives, namely:

1. The reduction of negative felling impacts on the residual forest stands.
2. Increasing the security of the workers.
3. Increasing the turnover of the tree by reducing splitting, ringshakes and ripping.
4. Preventing damage to the material by a regularly maintenance.
3. TARGET GROUPS AND COMPETENCE TO EDUCATE

3.1 Target group 1 Specialists

**Functions: Team leader, inventory clerk**
Profile of the function:
- The surveillance and judging the application of felling techniques by the fellers
- Correction of poorly application of controled felling techniques.

Required knowledge and competence:
- Management capacities
- Knowledge of exploitables species
- Basic knowledge of cartography
- Basic knowledge of a chainsaw
- Basic knowledge of conventional felling techniques.

Competence to acquire:
- In-depth knowledge of the principles and objectives of RIL
- Knowledge of controlled felling and crosscutting techniques
- Knowledge of the sharpening of the saw chain
- Knowledge of daily maintenance measurements
- Solid knowledge of security measures
- Basic knowledge of first aid.

**Feller**
Profile of the function:
- The application of controlled felling techniques, increasing
  - The security of the workers
  - The yield of the wood
  - The preservation of the residual forest stands
- Sharpening, which ensures a good short straight cut and a prolonged life span of the chain
- Correct and regular maintenance of the chainsaw.

Required knowledge and competence:
- Solid control of its chainsaw under any condition
- Solid command of conventional felling techniques
- Sound judgment of the position and the inclination of the tree to be felled
- Knowledge of the exploitable tree species
- Basic knowledge of cartography.
Competences to acquire:
- Profound knowledge of the principles and objectives of RIL
- Solid control of controlled felling and crosscutting techniques
- Solid knowledge of sharpening
- Solid knowledge of daily maintenance measures
- Solid knowledge of security measures
- Basic knowledge of first aid.

**Assistant-feller**
Profile of the function:
- To assist the feller during all activities such as the felling and crosscutting.

Required knowledge and competences:
- Experience in the function of assistant-feller
- Basic knowledge of conventional felling techniques
- Knowledge of exploitable tree species.

Competence to acquire:
- Knowledge of the principles and objectives of RIL
- Assistance to his feller during controlled felling
- Basic control of the controlled felling and crosscutting techniques
- Knowledge of chain saw sharpening
- Solid knowledge of daily maintenance measures
- Solid knowledge of security measures
- Basic knowledge of first aid.

3.2 Target group 2 Interested persons

Managers, civil servants (MINEF, etc.), researchers (Universities), Teacher-Instructors (ENEF), ONG Environnementales

Presentation of the following subjects:
- Principles and objectives of RIL
- Ecological effects to the forest due to conventional and controlled felling
- Various controlled felling techniques
- Sharpening
- Daily maintenance measures
- Security measures

3.3 Target group 3 Instructors

**Function**: Instructor of controlled felling at RIL level
Profile of the function:
- Instruction of controlled felling at all levels to the interested persons

Required knowledge and competences:
- Didactical and managerial capacities
- Solid control of the chainsaw under any circumstance
- Solid control of conventional felling techniques
- Judging the position and inclination of the tree to be felled
- Knowledge of exploitable tree species
- Basic knowledge of cartography.
Competences to acquire:

- Profound knowledge of the principles and objectives of RIL
- Solid control of controlled felling techniques, polling and crosscutting
- Solid knowledge of chain saw sharpening
- Application of felling techniques that increase
  - The security of men
  - The yield of the wood
  - Preservation the residual forest stands
- Sharpening which ensures a good straight cut and prolonged life span of the chain
- Correct and regular maintenance of the chainsaw
- Solid knowledge of daily maintenance measures
- Solid knowledge of cartography
- Solid knowledge of security measures
- Solid knowledge of first aid.

All certified!
4. TRAINING PROGRAMME

The training module is developed on the basis of the requirements mentioned here above and concerns the subjects, that will be elaborated in chapter 5.

All participants to the training are obliged to wear security helmets and vests during their stay in the forest.

4.1 Introduction of RIL techniques and interpretation of the impact of felling to the forest

Elements:
- Introduction, description
- Training programme
- Théorie of controlled felling techniques
- Security measures and material, first aid
- Evaluation and questions.

Duration: ½ day.
Personnel: 1 instructor.

Necessary materials:
- Blackboard or Paperboard + markers
- Illustrations on posters or by Power Point
- Manual of the operator for each feller participant.

Location: Assembly room.

4.2 Controlled felling techniques

Elements:
- Conventional felling demonstration by the fellers
- Controlled felling techniques démonstration by the instructors
- Controlled felling techniques training of the fellers
- Exam in controlled felling techniques by the fellers
- Crosscutting

Duration: 4 days
Personnel: 2 instructors (1 for 2 operators)

Necessary materials:
- 1 chainsaw with 1 spare guide bar and 1 spare chain
- First aid kit
- Inventory map of trees to be felled.

Location: Forest, inventoried and mapped compartment.
4.3 Crosscutting techniques

Elements:
- Conventional felling techniques demonstration by the fellers
- Correct techniques demonstration by the instructors
- Crosscutting training of the fellers
- Test in crosscutting techniques of the fellers

Duration: 1 day
Personnel: 2 instructors (1 for 2 operators)
Necessary materials:
- 1 chainsaw with 1 spare guide bar and 1 spare chain
- First aid kit
- Sharpening and riveting tools of the saw chain
- Inventory map with trees to be felled.

Location: Forest, inventoried and mapped compartment.

4.4 Knowledge and maintenance of the chainsaw and sharpening of the saw chain

Elements:
- Introduction, description
- Description of the chainsaw
- Daily maintenance
- Sharpening of the chain
- Test in maintenance and sharpening by the fellers.

Duration: ½ day.
Personnel: 1 instructor.
Necessary materials:
- Paperboard + markers
- Illustrations with model specification
- Chainsaw and chain
- Sharpening and riveting tools.

Location: Assembly room.
4.5 Training structure

Theoretical training:
• In the classroom
• Blackboard
• Technical sheet
• Lecture 5.1 – 5.6
• Chairs for all participants
• Questions.

Practical training:
• Observations of fellers: conventional felling, sharpening, maintenance
• Instruction: maintenance, security, sharpening, adjusting chain
• Demonstration controlled felling
• Instruction controlled felling
• Instruction assistant-fellers
• Instruction crosscutting
• Summary, manuals, certificates

Required conditions:
• Compartment with available relevant inventory maps
• Transport for the personnel on hold during the training

Mission to be fulfilled by the instructor:
• Explication of the importance of each RIL action concluding by questions and an open discussion
• Lecture
• Practical training to a group of students.

Facilities and materials:
• Blackboard or Paperboard + markers
• Illustrations on posters or by Power Point
• Sharpening and maintenance tools
• 2 complete chainsaws
• Security material
• 2 complete helmets
• Helmets for all participants
• Security vests for all participants

Personnel:
• 1 instructor
• 1 assistant-instructor
4.6 Calendar

4.6.1 Target group 1

- Team leader
- Inventory clerk, foreman
- Feller
- Assistant-feller

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### 4.6.2 Target group 2

- Managers (team leaders, foremen)
- Civil servants (MINEF, etc.)
- Researchers (University), teacher/instructor (ENEF)
- Environmental ONG’s

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### 4.6.3 Target group 3

Instructor in controlled felling techniques

*This calendar is to be followed twice: the first time as target group 1, the second time as assistant-instructor*

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5. ELABORATION OF THE SUBJECTS AND THEIR ELEMENTS

5.1 Introduction and interpretation of the impact of felling and RIL techniques

5.1.1 Introduction, description

The impact of felling to a tree in the forest consists of:
- The destruction of trees to be protected (future crop trees (FCT), seed trees, protected species)
- The destruction of the habitat of organisms in the trunk and the crown of the trees felled
- The destruction of the vegetation where the tree falls (trunk and crown)
- Damage to the residual forest by the vines pulling off the branches of neighbouring trees.

The trees to be protected (future crop trees, seed trees, protected species) have to be marked so that the feller can try to avoid them, but the margin in which he can direct the fall hardly ever exceeds 15 to 20 degrees at each side of the natural direction of the fall.

It is recommended to protect also the monumental trees, i.e. trees with a DBH or a diameter above the buttresses of over 2 metres.

The exploitation of these trees demands often so much efforts from the fellers and the extraction and loading engines, that the loss of time and material use does not justify in general the produced volume.
Furthermore, as these trees are often of a good genetic quality, they are of great importance to the natural regeneration of their species and to the forest in general.

Besides the damage to the residual forest, damage is done to the tree that has been felled, like pull-outs, cracks, ripping, ringshakes and tear-offs. The controlled felling techniques can considerably restrict these damages and the impact to the forest environment.

The sharpening and maintenance of the chainsaw are imperative subjects to the good functioning of this machine and for the security of its operator.

5.2 Description of the chainsaw and parts

1. **Carburator Pomp (easy starting)**
   Fills the carburator with petrol, facilitating the starter

2. **Lock button**
   Lock button of the carter and the carburator

3. **Chain brake**
   Causes the rotation of the chain to stop when it is activated by the operator in case of a kick back.

4. **Oilomatic Chain**
   Element composed of cutting teeth, intermediary links and guiding links

5. **Guide-chain**
   Supporting and guiding the chain of the chainsaw

6. **Chain tensioner (lateral)**
   With help of this facility one can adjust the correct tension of the chain

7. **Chain tensioner (frontal)**
   With help of this facility one can adjust the correct tension of the chain

8. **Tension adjuster, of the rapid chain tensioner**
   With help of this facility one can adjust the correct tension of the chain

9. **Gear**
The chain wheel which drives the chain

10. **Clutch cover**
   Covers the clutch and the gear

11. **Felling claw**
   Serrated support ensuring the pressure of the chainsaw onto the wood

12. **Chain reel (or: chain block)**
   Catches a broken chain and forces it into the cover

13. **Decompression Valve (easy starter)**
   Reduces the compression ratio, facilitating the start

20. **Silencer**
   Reduces the noise of the exhauster and guides it in the wanted direction

21. **Handle of the starter rope**
   Handle of the starter rope of the machine

22. **Connection of the spark plug**
   Connects the sparkplug with the sparking wire

23. **Oil tank cap**
   To open and close the oil tank

24. **Fuel tank cap**
   To open and close the fuel tank

25. **Universal command switch**
   Switch to set the starter, accelerator and stop

26. **Blocking of the accelerator**
   To be pushed in before operating the accelerator

27. **Accelerator**
   Controls the speed of the engin

28. **Tubular grip**
   Tubular grip in front of left hand on the foreside of the chainsaw

29. **Handprotection in front**
   Ensuring the protection against projected branches and helps to avoid that the left hand touches the chain if it slides off the tubular grip

30. **Back grip**
   Grip to support the right hand, situated at the back of the chainsaw

31. **Protection of the hand activating the accelerator**
   Ensures an additional protection of the right hand of the operator.

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**Tip of the chainguide**
Exposed extremity of the chain-guide (not illustrated)

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**Clutch**
Engages the engin with the gear when the engin accelerates above the idle speed (without illustration)

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**Anti-vibration system**
The anti vibration system includes a number of buffers created to reduce vibrations, created by the engine and by the saw chain onto the hands of the operator (without illustration)
5.3 Security prescriptions

5.3.1 General regulations

The use of the chainsaw can be dangerous. Its chain contains a number of very sharp saw teeth and when it is at full speed it can reach a speed of 70 km per hour!
Therefore never leave a chainsaw running without surveillance.
The specified security prescriptions have to be applied:
1. by the operator
2. to his clothing
3. to the chainsaw
4. to the use of it.

The operator
- The operator has to be in a good physical and mental condition and not be under the influence of alcohol or drugs.
- He must never operate the chainsaw in case of tiredness. The tiredness can cause a lack of control. At a minor signal of tiredness he has to take a break.
- The extended use of a chainsaw exposes the operator to vibrations that can cause the « white fingers » disease (symptom of Raynaud) or the syndrom of the Carpeian tunnel. These symptoms reduce the capacity of the hands to appreciate temperature, causing a insensibility of the fingers and a burning sensation. Use the AV (anti vibration) chainsaw model, wear gloves and use a well sharpened chain.

The clothing
- The cloths must be adjusted, leaving a complete liberty of movement. Avoid wearing loose-fitting or torn cloths.
- Wear leg protection.
- Gloves: Wear anti-slip gloves
- Shoes: wear solid boots or shoes with anti-slip soles
- Helmet: wear a approved safety helmet with ear and vision protection
- Vest: wear a bright coloured and reflective vest to be visible in the forest.

Safety clothing
Safety instruction for the chainsaw

- Never make any modification on the chainsaw

The modern chainsaw is equipped with the following safety facilities:

- Anti-rebound protection with chainbrake
- Blocking of the accelerator in order to prevent any accidental acceleration
- Safety chain
- Narrow extremity of the chainguide (limited rebound risk)
- Efficient vibration reducing system
- Chain sensor (hand protection in case of disconnection or chain rupture)
- Right hand protection (hand protection in case of disconnection or chain rupture)

All safety equipment of the chainsaw must be verified regularly in order to ensure their proper functioning.

The use of the chainsaw

Transport:

- Always stop the engine before putting it down or transporting the chainsaw. An accidental acceleration can put the chain in action
- Avoid to touch the hot exhaust/silencer
- The chain protector has to be placed and the guide bar must point at the opposite direction of the operator, so backwards
- In case of transport by car, disassemble the guidebar and place the chainsaw in a solid box.

Preparation for use:

- Remove the chain protection
- Verify if the chain, the chainguide and the chain wheel have the same pitch (.404 or 3/8)
- Chain tension: a correct chain tension is extremely important. Ensure that the cover screws are well tightened after the adjustment of the tension. Never start the chainsaw if the screws have not been tightened. Verify the chain tension after tightening the screws, and after each stop of the chainsaw.

Filling the fuel reservoir:

- Petrol is an extremely flammable fuel, great prudence is called for when filling the chainsaw. Never smoke and never handle the fuel close to a fire.
- Filling up at an aerated place and only in the open air.
- Always stop the engine and leave it cooling down before filling up
- Remove the reservoir cap of the chainsaw and let out the vapour
- Before starting the engine, wipe off all fuel that may have been spilled
- Verify eventual leaks
- Take care to not spill petrol on your clothes
- Take care that the reservoir cap has been well tightened in order to avoid that it might loosen during action. Tighten it first by hand and then with the screw driver/spark plug spanner
- Filling must be done at least 3 metres away from the working place.
- The operator and his assistant have to apply a filling discipline of each time filling first the oil reservoir before they fill the fuel
reservoir in order to avoid the lacking of filling the oil and that the chain will work without oil.

5.3.2 Starting the engine

Attention: this chainsaw is made to be used by one person only. No other person should be close to the running chainsaw. Nobody should assist the starting of the engine and the use of the chainsaw.

- The chain brake has to be on when starting the chainsaw.
- The chain saw must be handled in action by one person only and all other persons should stay at a distance from it.

Two methods are recommended to start the chainsaw:

**First starting method (starting on the ground):**

1. Place the chainsaw on the ground on a flat and clean surface
2. Engage the chain brake
3. Ensure that the chain does not risk to touch the ground or other objects
4. Hold the grip tightly with the left hand
5. Put the toe of your right foot in the back grip
6. Pull the handle of the starter rope slowly with the right hand pull until the resistance becomes perceptible
7. Pull powerfully in one fast movement.
Second starting method (lifted start):

1. Engage the chain brake
2. Ensure that the chain cannot touch your legs, arms or other objects
3. Take the front grip firmly in the left hand
4. Straighten the right arm
5. Hold the back-grip firmly between the legs just above the knees
6. Stay well balanced in a stable position
7. Pull the handle of the starter rope slowly with the right hand pull until the resistance becomes perceptible
8. Pull powerfully in one fast movement.

Chain Lubrication Control
- The chain must always spray some oil. If the chain runs dry, it will encounter serious irreparable damage.
- Each new chain needs a test run period of 2 to 3 minutes
- Grow accustomed to filling the chain oil reservoir always at the same time and before filling up with fuel!
5.3.3 Rebound (“kick-back”)

A kick-back effect occurs when the superior quarter of the tip of the guide bar touches a solid object or gets stuck.

In some circumstances, the guide bar moves to the direction of the operator who might encounter serious or even fatal injuries. The kick-back can also occur when the tip of the guide bar gets stuck unexpectedly, when it touches a solid object in the wood or if the chainsaw is not correctly used at the beginning of the felling in the heart or mortise. The kick-back can also occur during crosscutting.

Most of the modern chainsaws are equipped with a chain brake which serves as a protection for the hand and which is activated with a kick-back when touching the grip or the left forearm. Besides, some type of guide bars and chains are made in a way to reduce the force of a kick-back. The use of these types of guide bars and chains is strongly recommended.

An incorrect reduction or modification of the depth speed limiter or an incorrect shape of the cutting teeth can increase the risk of a kick-back.

Recommendations to avoid a kick-back:
1. Hold the chainsaw strong in both hands
2. Keep the thumb beneath the tubular grip
3. Always look at the tip of the guide bar
4. Take care that the tip of the guide bar does not touch any object
5. Do not cut branches with the tip of the guide bar
6. Do not lean too much forward
7. Do not saw with the arms high
8. Start felling at full speed
9. Only fell one only trunk at a time
10. In a cut already partly opened the guide bar has to be introduced with extreme prudence
11. The mortise is to be executed by experienced operators only
12. Take care that the trunk does not move and does not change position and may lock the chain
13. Take care with small branches and undergrowth in which the chain risks to get stuck
14. Work with a good chain, well sharpened and well tightened
15. Keep away from the longitudinal axe of the saw.

5.3.4 Traction forces and Ricochets

Traction forces:

Traction forces can occur when a part of the chain on the inferior part of the guide bar is suddenly stopped when it gets stuck or when it gets in contact with a strange object hidden in the wood. The chain reaction pulls the chainsaw in front and the operator risks to loose control. These traction forces can often occur when the claw of the chainsaw is not strongly pushed against the wood to be felled and when the chain does not work at full speed before attacking the wood.

Attention must be paid when felling the undergrowth in which the chain can get stuck, which risks the loss of balance.

Recommendations in order to avoid traction forces:
1. Always start felling with a running chain at full speed, the claw must be pushed tightly against the wood
2. Keep an already existing cut open with wedges before introducing the saw.

Ricochet:

A ricochet can occur when the upper part of the chain of the guide bar is suddenly stopped when it gets stuck or gets in contact with a unknown hard object hidden in the wood. The chain reaction pushes the chain saw towards the operator who might loose control of the machine. The ricochet often occurs when the upper part of the guide chain is used for crosscutting.
Recommendations in order to avoid a ricochet:
1. Pay attention to forces or situations which risk to cause the upper part of the chain to get stuck in the wood.
2. Never saw more than one piece of wood at the same time
3. Do not warp the chainsaw removing the guide of a mortise or a cut made from the bottom to the top, causing a risk for the chain to get stuck.

5.4 Controlled Felling Techniques

The entire actions of controlled felling can be demonstrated on a small tree with a diameter of about 20 cm)

Demonstration at small scale
5.4.1 *Determination of the direction of the fall and opening of escape ways.*

Before felling a tree, you have to take into consideration all possible conditions which might effect the direction of the fall, like:

- the expected direction of the fall
- The naturel inclination of the tree (use a leader)
- Any strong structures of branches
- Asymmetric shape of the tree
- Shape of the buttresses
- Slope
- Condition of the tree (dead branches, holes, rotten heart). Where is a strong assumption of a hole or rotten heart the trunk has to be hit with a hammer or an axe for a hollow sound and to be confirmed by piercing with the chainsaw into the trunk
- Surrounding trees and obstacles (fallen trees, rocks)
- The direction and the force of the wind.

**Use of a leader**

The direction of the fall being determined, the escape trails are opened as shown here below:
• Open two escape trails, oriented to the opposed direction of the fall, but under an angle of about 45°, so at 135° and at 225° away from the direction of the fall
• Clean the trail of all obstacles: twigs, bushes, lianes. The twigs have to be cut off close to the ground

![Twig cut off too high](image)

• On a steep slope escape trails have to be planned parallel to the slope
• Put tools and materials at a sufficient distance, but never on the escape trails.

5.4.2 Safety measures before and after the felling

Verification of elements that can create dangerous situations:

• Dead branches
• Vines attached to the crown of another tree
• The crown is entangled with those of other trees
• The tree to be felled is inclined
• Another tree is leaning on the tree to be felled
• Strong wind

Safety measures to be taken:

• Only experienced persons are authorised to execute felling
• Only persons belonging to the felling team are allowed in the felling zone
• Always take into consideration the condition of the tree: a tree with a rotten heart, a sloped tree or a tree containing a risk to split or break, can possibly cause serious injuries, even fatal injuries to persons in the vicinity
• Pay attention to dead or broken branches which might break off under the effect of the vibrations and fall on persons in the vicinity
• Before starting the felling, the feller has to ensure that no one is in the danger zone
• When felling a tree on a slope, the operator should, if possible, keep away from the compression (downhill) zone of the tree for the directional cut
• Before felling near a road, particular safety measures should be taken. A person has to be placed outside the danger zone on the road to stop all...
traffic and a road sign must be put at both sides of the road in the danger zone

- During the felling a distance of at least two and half times the length of the tree in relation to the most nearby person must be respected

- Before applying the felling cut, stop the engine of the chainsaw and alert all persons possibly finding themselves in the surroundings of the coming fall of the tree, by shouting out loud or by whistling

- When felling always keep to the side of the trunk and always move away sideways to regain the escape trail, so do not stand in the opposite extension of the falling direction

- At the beginning of the fall stop the engine of the chainsaw before regaining the escape trail

- When moving away from the falling tree, pay attention to branches which might get torn off by vines and drop, by observing the crown of the tree

- After the fall of the tree wait a few minutes looking at the crowns of the remaining trees for branches or pieces which might detach and fall

- It is prudent to alert all persons in the surroundings of the successful fall of the tree by shouting out loud.
5.4.3 Preparation of the trunk and the action area around the trunk

- Liberately the trunk and the action area of all possible obstacles (branches, lianes, bushes, termite hills, etc.) in a way that the persons working in this area do not risk to stumble.
- Clean meticulous the bottom of the trunk of sand, rocks, termite hills with a cutlass in order to avoid the blunting of the chain.
- Remove the large counterforts by making a vertical cut then a horizontal cut.

Trunk well cleaned and cleared
5.4.4 Directional cut / felling cut

The sighting line, a vised rib in black paint on the cover and on the carter of the chainsaw helps to control the falling direction when cutting the directional cut

- If the tree has large roots or, as in most cases in african woods, large or high buttresses, these have to be cut before by a horizontal cut and then with a vertical cut in order to remove the piece of buttress
- Make the directional cut as close as possible to the ground
- **Never make a directional cut in the buttress, but in the trunk of the tree**

When making the directional cut, the chainsaw has to be positioned in a way that the sighting line will be exactly oriented in the falling direction

![Directional cut well aimed](image)

- Make a horizontal cut controlling the direction of the fall with a vised rib
- Make a oblique cut of about 45°

- The directional cut must be executed in a straight angle on the direction of the fall
- **The two cuts must join at one only spot without surpassing one or the other cut**
Directional cut in a dressed buttresss

- Before going to the other side of the trunk, engage the chainbrake
- The depth of the cut must not surpass 1/5 of the diameter of the trunk
- Control the directional cut and correct if necessary.

5.4.5 Cut of the mortise

The technique of the cut of the mortise is a new development in felling of tropical trees, which increases considerably the safety and decreases the risks of cracks. This technique enables the feller to decide exactly at what moment he wants the tree to fall.

It is however recommended to apply this technique only after receiving a solid and relevant instruction and using a chain with a minor risk of kick-back.

The technique of mortise is recommended to all trees. It is executed in the following way:

- A wooden twig with a length surpassing the diameter of the tree is placed in the hindmost part of the directional cut serving as an indicator of the height of the cut. It has to be clearly visible for the feller.
- At a distance of 4 fingers on both the horizontal plan and the vertical plan from the directional cut, the feller penetrates the tip of the guide bar exactly parallel to the directional cut into the trunk over the length of the guide bar and guided by the twig. The strip of wood not cut serves as a hinge at the moment of falling. It is extremely important that this mortise is executed on a perfectly horizontal plan
Marking the position of the hinge

- The chainsaw then cuts the trunk towards the opposite side of the directional cut, but stops at twenty to thirty centimetres (depending on the diameter of the tree) of the bark of the trunk
- If the diameter of the trunk surpassed the length of the guide bar, the same process is repeated on the opposite side
- Thus a hinge of about ten to fifteen centimetres width is created at the height of the directional cut and the mortise cut

- On the opposite side of the directional cut a part of the trunk is left uncut, called «the security»
- The hinge and the security keep the tree perfectly straight-standing.
5.4.6 Cutting the sapwood

The cutting in the sapwood at the sides of the directional cut already made, there where the hinge will be created, will prevent the sapwood and a part of the wood to tear loose at the moment of falling of the tree.

- Slice in the sapwood at both sides of the trunk, at the same height of the basis of the directional cut till the perfect wood.

5.4.7 The felling cut

- The feller stops the chainsaw and alerts all persons who might be in the surroundings of the approaching fall of the tree by shouting out loud or whistling.
- The assistant feller moves away with the tools
- The feller activates the chainsaw and starts the felling cut in the oblique direction in the exact direction of the end of the mortise cut
- The tree starts to fall slowly
The feller takes away the chainsaw, stops the engin and moves away by the escape trail, observing the crowns of the residual trees for branches or other residue which might be torn off and fall.

5.4.8 Conventional felling cut

Trees with small diameter (< 60 cm, measured between eventual buttresses) in tropical forests are felled exactly as in Europe. Safety and preparatory actions and directional cut and sapwood cut are made in the same way as before the mortise (see 5.4.2, 5.4.3, 5.4.4 et 5.4.5).

- All safety precautions taken, all area and trunk preparations made and the directional cut and the sapwood cut at both sides applied, the feller starts the felling cut at the opposite side of the directional cut, but about 4 centimeters above it.
- A twig longer than the diameter of the tree and placed into the back of the directional cut serves as indicator of the height of this cut. It must constantly be in sight of the feller.
- The feller stops the chainsaw and alerts all persons possible being in the surroundings of the approaching fall of the tree by shouting out or whistling loud.
- The operator activates the chainsaw again and starts the felling cut.
- The cut must be made perfectly horizontal.
- As the cut approaches the presumed place of the hinge, the guide bar has to be held as parallel as possible to the twig in the directional cut in order to keep the width of the hinge even over his complete length.
- When the guide bar is well advanced into the trunk, a thin, long twig is placed into the cut.
- A wedge is always knocked with power into the felling cut to keep it open in order to avoid that the blade gets stuck (compulsory!)
- The assistant feller carries away all tools.
- The feller fixes his view to the twig in the felling cut during the cut.
- When the tree starts falling, the gap of the cut opens and the free end of the twig bends downwards, indicating clearly to the feller that the fall is setting in.
- On the other hand, if the freer end of the twig goes up, this indicates, that the cut is closing, and the feller has to take away the blade, stop the engin and place a wedge in the cut in order to avoid a complete closing of the cut.
• If the cut is about 4 fingers from the directional cut and the tree does not already indicate his fall, the chainsaw has to be removed and the wedge is to be knocked further into the cut or a thicker wedge is to be added, to force the fall.

• If the tree still has an tendency to fall to the opposite side of the directional cut, the procedure has to be repeated largely above the first directional cut, but on the opposite side, so:
  - 5.4.1 : Escape way
  - 5.4.4 : Directional cut
  - 5.4.5 : Cutting the sapwood
  - 5.4.8 : Conventional cut

• The tree starts slowly to fall
• The feller takes away its chainsaw, stops the engine and moves away to the escape way, still observing the crowns of the residual trees for branches or other kind of wood that might get detached and fall.

5.4.9 The role of the assistant feller

Before the felling:
1. Clean the tree trunk
2. Prepare the escape way
3. Cut off the stalks on the escape way nearby the ground
4. Prepare the twigs for the indication of the cutting.

During the felling:
1. During the actual felling the assistant keeps an eye contact with the feller
2. During the removal of buttresses the assistant surveys the other side of the buttresses and guides the feller by hand signals so that the buttress will be cut in a correct horizontal and vertical way
3. After the directional cut, the assistant places a twig in the back of the directional cut, its length surpassing the tree-trunk in order to guide the feller to cut the hinge correctly parallel to the directional cut

The assistant guides the feller with a twig
4. During the directional cut the assistant, if necessary, has to survey and guide the end of the guide bar on the other side of the tree where the feller is not able to see,

5. When the feller announces the fall, the assistant surveys the crown; in case of danger, he alerts the feller by shouting out loud and throwing a lump of earth at him.

5.5 Bucking and crosscutting techniques

5.5.1 Description, methods

The bucking i.e., the separation of the tree crown, is in general done some time after the felling (about one week or more) in order to decrease the tension of the wood. This is important for species with a larger risk of cracking. This measure also allows for a larger safety level, as during the fall of the trees, vines attached to the crown and linked to other crowns risk to rip off dead branches which might seriously injure persons below. In the third place there is a risk to disturb the wasp or bee nest by the felling. These animals are generally gone after some days, enabling the chainsaw operator to approach the crown without risk to get attacked.

The bucking of the butt of the trunk is not treated here, since it is considered important to be done in the park, where one can have a better impression of the quality of the trunk in order to decide how the logs should be crosscut. For this it is necessary that the buttresses are removed during the felling operation.

A correct cutting of the buttresses at the felling:
- Reduces the damage to the ground
- Reduces the felling resistance
- Enables to get a better yield from the tree.

The recommended method is the entire action of approach, positioning and the clearing of the tree trunk executed solely by the chainsaw operator (and eventually with his assistant) with his cutlass. This method reduces the use of the bulldozer and prevents at the same time damage to the environment caused by the bulldozer creating space for the chainsaw operator.

Bucking of the crown
Clearing of the tree is often executed by a bulldozer before bucking. The chainsaw operator accompanies the bulldozer to the felled tree. The bull first approaches the butt of the tree, clears it of all vegetation and lifts up the butt in order to facilitate the passing of the hook when fixing the cable. Then the bull moves to the start of the crown and removes also the vegetation facilitating the chainsaw operator to separate the crown.

This method is easier for the chainsaw operator, as he arrives in a clean space to stand in a stable position.

On the other hand, it destroys vegetation on a large scale, not only on the space besides the crown, but it often scrapes off the vegetation along the entire trunk, from the butt to the crown. This technique is therefore considered « not – RIL ».

The more, there is a long moment of immobilisation of the bull waiting for the completion of the crosscut.

5.5.2 Choice of spot to cut off the crown

The best place for cutting off the crown is in the fork of the first branch of the crown. This reduces the risk of cracking during the bucking as the structure of the wood in the fork is much more dense because of irregular and knotted grain.

At the same time, the operator cannot dissipate useful wood by crosscutting on a lower part of the trunk. A correct bucking is proved by a double heart on the face of the cut and has to be a judgement condition for the manager. As a double heart is considered as a deficiency, this will be eliminated after skidding to the log yard.

Correct bucking, showing the double hearts

The crosscutting of the trunk is only done at the stump when the whole trunk is too heavy or too long. In this case the spot for crosscutting is marked by the manager or the assistant of the log yard, who are experienced in quality judgement and all conditions concerning the length.

The cutting has to be done in an spacious log yard, where the quality of the logs can be judged in a better way.

5.5.3 Crosscutting and bucking techniques

With crosscutting is meant the cutting in two of a tree or log
By bucking is generally meant the cutting off an end of a log or a crown or buttresses of a tree. For reasons of correct judgement of the cutting spot in order to obtain a maximum quality of a log it is recommended to cut the tree at the log yard. Only if the tree is too heavy or too long to be transported in one piece, the crosscutting has to be done at the stump.

- The tree has to lie as flat as possible with its larger part touching the ground
- The log has to be supported on both sides of the foreseen crosscut with wooden struts
- After measuring the total length the log yard assistant chooses the crosscutting spot considering defects to be eliminated at the end or on the trunk and considering the requested lengths. He marks the spots with crayon or small cuts in the bark
- The chainsaw operator cleans with a cutlass meticulously the foreseen spot removing all sand, mud or pieces of bark.
- Then he clears the part of the log lying on the ground so that the chainsaw will not cut into the soil.
- After engaging the chainsaw, the operator places it exactly square on the spot to crosscut and accelerates in order to start cutting. Do not pressure too hard, because a well sharpened chain will “eat” its way in the wood by itself.
- When the guide bar has entered about 20 cm into the wood (more than 2x the width of the bar), a plastic, aluminium or wooden wedge is knocked into the cut to avoid the bar to get stuck

Correct crosscutting (use of wedge and struts)

- Trees with a large diameter, wider than the guide bar, have to be cut first on one side next on the other side.
- Another technique is to climb on the log after having cut one side, inclining the chainsaw downwards thus cutting the superior part of the trunk and lastly, to get down to the other side of the trunk to cut the last part. With this technique it is important that the operator stays in a very stable position.
• Trees with a diameter over twice the guide bar (90 cm) have to be cut with a guide bar with a length of 1,05 metres or 1,20 metres and a corresponding chain.

Crosscutting the tree under tension:
• If the part of the tree to be crosscut os off the ground, both sides of the crosscutting spot have to be supported by struts made out of offcuts to avoid cracks in both logs when the cut is almost completed.
• If it is not possible to support both sides the following technique is to be applied (see A):
  1. Always execute a clearance cut (1) on the compression side to a depth of 1/3 of the tree’s diameter
  2. Always knock a wedge in the cut, when the guide bar is sufficiently entered
  3. Then execute the final cut (2) on the traction side till both cuts meet, where the remaining wood will break apart
• If a part the tree is suspended such that it can not be supported, the following technique is to be applied (see B):
  1. Always execute a clearance cut (1) on the compression side to a depth of 1/3 of the tree’s diameter
  2. Then execute the final cut (2) on the traction side till both cuts meet, where the remaining wood will break apart.

5.5.4 Safety mesures
• If the to be cutted part to be cut is under lateral tension, first clear an escape trail
• If the log or tree lies on a slope and there is a risk that the tree or log can roll away, first cut the downhill part and next the uphill part
• Always use a wedge to avoid the guide bar to get stuck
5.6 Sharpening the saw chain

5.6.1 General conditions

A perfectly sharpened saw chain penetrates the wood without difficulty, even with the least pressure.

Never cut with a blunt or damaged chain. This will make the cutting more tiresome, the parts get worn faster and the result of the cut is not satisfactory. A incorrectly sharpened chain, particularly depth limiter being too high, can increase the risk of kick-back of the chainsaw and consequently cause serious injuries.

Every evening the saw operator has to:
- Clean the chain with gasoil and remove all sawdust and resin
- Verify if the links are not cracked and the rivets not damaged

Every evening the chainsaw mechanic has to:
- Replace all damaged or used chain parts and sharpen the new teeth and file the depth limiter down to the size of the other parts of the chain

The pitch of the chain is marked on each cutting tooth. The operator has to check every new chain if its pitch (3/8” or .404) corresponds with the sprocket of his chainsaw.
5.6.2 Manual sharpening tools

- Round files: the diameter of used round files have to be in relation to the pitch of the chain. A chain of .404 takes a file of 3/16” and a chain of 3/8” a file of 5/32”
- A file holder with markings for a correct sharpening angle
- A sharpening caliber to control the sharpening angle, the front angle, the height of the depth limiter, the length of the teeth and the depth of the slot. A small projection at the end of the caliber serves to clean the groove of the guide bar and the small holes for the chain oil
- A flat file to file the depth limiter.

5.6.3 The correct sharpening

At the resharpening of the cutting teeth, the below given angles have to be respected.

<table>
<thead>
<tr>
<th>Chain Type</th>
<th>Angle in °</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Rapid-Micro (RM)</td>
<td>30</td>
</tr>
<tr>
<td>Rapid-Super (RS)</td>
<td>30</td>
</tr>
<tr>
<td>Picco-Micro (PM/PMN)</td>
<td>30</td>
</tr>
</tbody>
</table>

A = Sharpening angle = cutting angle
B = Front angle = lateral angle

Tooth shapes:
Micro = half squared gouge
Super = squared gouge

If the prescribed files and sharpening tools are used and the correct adjustments are applied, the prescribed values for the angles A and B are obtained automatically.
The more, all chain teeth must have the same angle. Uneven angles will cause an irregularly functioning by shocks and rapid wear leading to a breaking of the chain.
To meet these conditions it is necessary to be well experienced in sharpening.

Method:
1. Choose correct sharpening tools according to the pitch of the chain
2. To clean the chain of remaining oil, make a cut in a piece of offcut
3. Fix the guide bar into the STIHL vice or in a cut in a piece of wood (big branche, offcut, etc.)
4. **Take care that the chainsaw is placed on a horizontal surface**
5. Engage the chain brake by pushing the hand protection forwards
6. Disengage the chain brake when the chain has to be moved forwards to sharpen the next number of teeth by pulling the hand protection backwards, but engage it immediately afterwards again
7. Look first for the most damaged tooth before starting to sharpen and file that one down until the burr is filed off, whilst counting the number of strokes needed, then sharpen all other teeth with the same number of strokes. This way all teeth will have the same shape.
8. Sharpen the chain regularly, but remove only little. For a simple resharping it will generally be sufficient to apply only two or three strokes of the file. **Meanwhile, the same number of strokes has to be applied to all teeth. Irregular lengths of the teeth can be observed by the different height of the teeth, this will cause shocks when cutting which may lead to a rupture of the chain**
9. Guiding the file:
   a) With the file holder: follow the indicated angles marked on the horizontal surface of the file holder (at a straight angle in relation to the flank of the guide bar). Put the file holder on the top of the teeth and the depth limiters
   b) With a magnetic plate: a plastic plate with markings of 30° and 35° and magnets at the end placed on the guide-blade, just below the chain. The markings serve as guide for the file.
Magnetic plate indicating the sharpening angle

10. File from the interior to the exterior of the tooth
11. Lift the file up while returning (it should only lime when going forwards)
12. Do not touch intermediary links with the file
13. Turn slightly in the longitudinal axis of the file by regular intervals (but preferably at each time) in order to avoid onesided wear
14. Check the angles of all teeth with a sharpening calibre

Reducing the height of the depth limiter:
The depth limiter determines the penetration depth of the teeth into the wood, and, consequently, the thickness of the shavings. Prescribed difference of the height of the depth limiter and the cutting side of the tooth = a.

Adjustment of the depth limiter:
The difference in height of the depth limiter and the cutting side of the tooth decreases when sharpening the cutting teeth.

The rectification of the limiter is done with a flat file.
After each sharpening, check the height of the depth limiter

Place the sharpening caliber which corresponds with the pitch of the chain on the chain. If the depth limiter is higher than the sharpening caliber, the depth limiter shall be rectified (filed off)

Rectify the depth limiter in a way that it levels with the sharpening caliber

Then rectify obliquely the height of the depth limiter, parallel to the maintenance identification mark, take care not to file off too much of the top of the depth limiter

Place the sharpen caliber on the chain. The top of the depth limiter has to touch slightly the sharpening caliber

NB.: Depth limiters of which the height is reduced too much, increase the risk of a kick-back of the chainsaw.

After sharpening, clean the chain meticulously, remove filings from the chain and lubricate abundantly.

In case of a prolonged stop, clean the chain with a metallic brush and keep it well oiled.
5.7 Maintenance of the chainsaw

The chainsaws with their guide bars and chains have to be taken back to the base every evening for verification, cleaning with air pressure and if necessary, repairs.

5.7.1 Maintenance by the feller

Once a day:

**Chain**
- Check and sharpening
  - Sharpening angles
  - Depth limiter
  - Teeth length
  - Gouge angle
- Check:
  - pressure
  - grease control
- Cleaning:
  - Gasoil cleaning (resin)

**Engin**
- Check:
  - Chain break
  - Accelerator
- Cleaning:
  - Airfilter
  - Fixation of the guide-chain

**Guide bar**
- Check:
  - Wearing
  - Worsening of quality
- Cleaning:
  - Grooves
  - Greasing holes
  - Smoothen off burrs

If necessary during the felling/crosscutting:
- Sharpening the chain:
  - Angles
  - Teeth length
- Check chain:
  - Tension of the chain; *tighten regularly !!!*
### 5.7.2 Maintenance by the chainsaw mechanic

**Daily:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Task(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airfilter</td>
<td>- Clean with air pressure or hot water and some soap (no mixed petrol!!).</td>
</tr>
<tr>
<td>Whole chainsaw</td>
<td>- Clean with air pressure</td>
</tr>
<tr>
<td></td>
<td>- Function control (start)</td>
</tr>
<tr>
<td></td>
<td>- Repair if necessary</td>
</tr>
<tr>
<td>Accelerator</td>
<td>- Function control</td>
</tr>
<tr>
<td>Accessible bolts, nuts</td>
<td>- Tighten:</td>
</tr>
<tr>
<td>and screws</td>
<td>- Grip</td>
</tr>
<tr>
<td></td>
<td>- Tubular grip</td>
</tr>
<tr>
<td></td>
<td>- Exhaust pipe</td>
</tr>
<tr>
<td></td>
<td>- All other screws, bolts, nuts</td>
</tr>
</tbody>
</table>

*This is very important for the new chainsaws during the first days!*
Every week or earlier if necessary:

<table>
<thead>
<tr>
<th>Component</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide bar</td>
<td>• To smoothen off the tip of the guide bar with a grindstone</td>
</tr>
<tr>
<td>Spark plug</td>
<td>• To adjust the interspaces of electrodes and clean</td>
</tr>
<tr>
<td>Oil pump</td>
<td>• To check the setting</td>
</tr>
<tr>
<td>Clutch bearing</td>
<td>• To grease the bearing</td>
</tr>
<tr>
<td>Sprocket</td>
<td>• To check on wear, replace if necessary</td>
</tr>
<tr>
<td>Cylinder</td>
<td>• To clean</td>
</tr>
<tr>
<td>Silent blocks</td>
<td>• To check the anti-vibration system (broken rubbers or springs)</td>
</tr>
</tbody>
</table>

Once a month:

<table>
<thead>
<tr>
<th>Component</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter</td>
<td>• To disassemble, clean and check the rope</td>
</tr>
<tr>
<td>Oil reservoir</td>
<td>• To clean with petrol or replace</td>
</tr>
<tr>
<td>Filter in the fuel reservoir</td>
<td>• To clean or replace</td>
</tr>
</tbody>
</table>
6. SELECTION OF REFERENCES

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