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Arboriculture and Urban Forestry
Training
Modules

Module 1

Introduction and orientation in Arboriculture/Urban Forestry

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section provide to the candidates with efficient information so that they could understand the essence of Arboriculture and Urban Forestry.

Candidates credited with this are able to:

- ▼ Define Arboriculture and Urban Forestry.
- ▼ Know the qualities of Arborists, Arboriculture and Urban Forester.
- ▼ Declare why people care for trees.

Key Terms		
Arboriculture	Organic agriculture	Arborist
Horticulture	urbanized	Architects
Silviculture	Urban Forest	landscape

Introduction:

- ▼ Arboriculture is the proper selection, planting, care and maintenance of all woody shrub, vines and trees outside their natural environment to ensure their longest successful contribution to the urbanized setting ensuring safety, health and measurable asset values.
- ▼ Arboriculture separate from Horticulture, silviculture or conservation forestry – but lends from and is partially integrated with these disciplines.
- ▼ Arborist's job is to secure highest quality existence of single or grouped trees in urbanized areas (non natural), e.g. Kruger Park.
- ▼ Arborist work with landscape architects, town planners, architects, home owners and estate grounds men.

Orientation:

- ▼ **Arborist's -, Arboriculture's -, Urban Forestry's qualities:**
 - Love the environment and wants to make a tangible contribution daily
 - Enjoy focused physical and mentally challenging work
 - Good relation with people who are tree owners or custodians

► Why do people care for trees?

- Trees are assets which can, should and are measured – Looking at size, species, status while evaluating its position in landscape (* See latest Arboriculture News – latest edition, ‘Landscape appraisal’.
- 100ha daily are urbanized and trees are needed to ensure quality of life for human inhabitants.
- The importance in a community is a parameter of peoples view of the future and their abundance, health and maintenance strategy give into our current civilization many generations from now.
- No matter why – for aesthetic, crime reduction, CO₂ uptake and O₂ release, sound or noise pollution, pollution filters, persipitation, cooling or warming effects, sentiment or financial gain –trees and their maintenance is a good idea.

Basic Tree Biology

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section present to the candidates efficient structures, functions and explanations existing when studying tree biology.

Candidates credited with this are able to:

- ▼ Learn the structure and functions of the roots, stem and leaves and understanding their interaction.
- ▼ Explain and understand compartmentalization.
- ▼ Learn the basic composition / structure of a tree’s vascular system and how water is transport within.

Key Terms		
roots	compartmentalization	cambium
meristems	CODIT	xylem
vascular system	cork cambium	phloem

Roots:

- ▼ Roots has four primary functions: - anchorage, storage, absorption, conduction.
- ▼ Roots grow where moisture and oxygen are available. Most absorbing roots are found in the upper 0.5 meters of soil. Horizontal, lateral roots also found near the soil surface, while sinker roots grow vertically downward off these lateral roots, providing anchorage and increasing the depth of soil exploitation by the root system.
- ▼ Roots can extend laterally for considerable distance, depending on soil conditions and structural influences. The extent and direction of root growth is more a function of environment than genetics. The main

function of large roots are (1) Anchorage and (2) Conduction.

- ▲ The absorbing roots are small, fibrous and grow at the ends of main woody, roots. They are covered in root hairs which aid in the uptake of water and minerals.

Stem:

- ▲ There are two types of meristems: 1) Primary – which produce the cells that result in elongation of shoots and roots; and 2) Secondary (lateral) – which produces cells that result in increases in diameter. It is this secondary meristem, in stems and branches, that allows a tree to grow so large.
- ▲ The primary meristems are located at the ends of shoots and roots and are called apical meristems. Trees have two lateral meristems. The first is called the cambium. The cambium is a thin, continuous sheath of dividing cells that produces the cells that will become the vascular system of the tree. It produces two kinds of tissue : 1) Xylem to the inside and 2) Phloem to the outside.
- ▲ The second lateral meristem is the cork cambium which produces the bark. The bark is a protective tissue that moderates the temperature inside the stem, offers defense against injury and reduces water loss.
- ▲ The xylem has four functions :
 - Conduction of water and mineral elements.
 - Support of the weight of the tree.
 - Storage of reserve.
 - Defense against the spread of disease and decay.
- ▲ The xylem can also be divided into :
 - Sapwood, which is the active part of the stem; and
 - Heartwood, which is the inner zone and composed of dead cells, is inactive and darker in color.
- ▲ The phloem is responsible for the movement of sugars, which are produced in the leaves, to the other parts of the tree e.g. the roots.
- ▲ When a tree has been cut and a cross-section is viewed, one can see the growth rings in the xylem. These rings are the annual production of xylem by the cambium. They are seen as rings because the relative size and density of the vascular tissue change through the growing season. As the season progresses, cells become smaller in diameter. Thus the contrast between cells produced later , allows the diameter increase within an individual year to be seen.
- ▲ In addition to xylem and phloem, the vascular system of a tree also ray cells. They grow across the xylem and phloem to form a ray from the inside to the outside. Their function is to transport sugars and other compounds through the cross-section of the stem and also assist in

restricting decay in wood tissue.

Canopy / Crown

- ▲ Each branch of the tree is similar in structure and function to the entire tree crown. Branches are strongly attach to the stem beneath and weaker above. The annual production of layers of tissue at the junction of the stem is apparent, forming a shoulder or bulge around the branch base and called the branch collar.
- ▲ In the crotch, the branch and trunk expand against each other and as a result , bark is pushed up forming the branch bark ridge. If bark in the crotch is surrounded by wood, it is call included bark and that will weaken the branch attachment.
- ▲ Leaves are the food producers of the tree. They contain chlorophyll, that gives a leave its green color and absorbs sunlight and CO₂. The energy of the sunlight is then converted to chemical energy in the form of sugar – the reaction / process is called photosynthesis. Oxygen, which is the by-product of this reaction is released.
- ▲ The role of leaves are transpiration i.e. the loss of water though the foliage in the form of water vapor. This cool the leaves and creates a “transpirational pull” that moves water up through the xylem.

Compartmentalization

- ▲ This is the process by which trees limit the spread of discoloration and decay. After a tree has been wounded, reactions are triggered which cause the tree to form boundaries around the wounded area.
- ▲ A proposed model of this compartmentalization process is called CODIT (Compartmentalization Of Decay In Trees) where the tree forms four barrier walls.
- ▲ Wall 1 resist the vertical spread of pathogens by plugging the xylem. Wall 2 resist the inward spread by depositing chemicals in the decay cells. Wall 3 inhibited lateral spread by activating ray cells to resist decay cells. These three walls form the reaction zone.
- ▲ Wall 4, or the barriers zone, is the next layer of wood to form after injury and protects against the outward spread of decay. It therefore separates the inner infected wood from the healthy wood that continues to form after the barrier zone is completed. Wall 4 is the strongest and rarely fails.
- ▲ Walls do not stop pathogens, they resist their spread. Sometimes the tree cannot resist the spread of aggressive pathogens. It is fairly common for walls 1-3 to fail, allowing decay to spread inside the tree, forming a hollow cavity.

Tree establishment

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section give candidates good planting and care procedures and techniques.

Candidates credited with this are able to:

- ◀ Learn the techniques and procedures used to plant and transplant trees.
- ◀ Understand how using proper techniques can improve survival chances and accelerate establishment.
- ◀ Become familiar with the use of chemical tree spades and their limitations.
- ◀ Know the advantages and disadvantages to staking or guying newly planted trees.
- ◀ Learn the techniques used, and know when staking is appropriate.
- ◀ Understand the special requirements of newly transplanted trees, and become familiar with early care procedures.

Key Terms

Selecting quality trees and remedial treatment

Safety awareness in Arboriculture / Urban Forestry

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section study protective equipment to assure that candidates have appropriate safety policies and an established precautious safety attitude that exclaim safety to be the first concern and that it requires conscious recognition of potential hazards and preventing accidents.

Candidates credited with this are able to:

- ▶ Recognize potential hazards and prevent accidents at a personal level.
- ▶ Recognize potential hazards and prevent accidents at a general level.
- ▶ Recognize potential hazards and prevent accidents in chainsaw department.

Key Terms		
hazards	chainsaw	climbers
kickback	chippers	ground crew

ANSI Standards: American National Standards Institute professional standards for safety and practice. The standards are written by an industry panel and approved by the profession.

Personal Safety:

Leg Protection

1. ANSI Z133.1 (1994) – Leg protection should be worn while operating a chainsaw during ground operations.
2. Types
 - ▶ Chaps: – can be used by multiple operators adjustability in size
 - ▶ Wrap-chaps: - provide additional protection by wrapping around more of the leg to allow for possible “pull” of the chainsaw.
 - ▶ Chainsaw pants: - newer styles are lightweight, washable and allow more flexibility
 - no need to wear work pants underneath
 - ▶ Bib style pants: - newer styles are lightweight, washable and allow more flexibility
 - no need to wear work pants underneath
 - no need for a belt – easy fit with climbing saddle
3. Materials
 - ▶ Jamming type: - long strands of fiber such as wrap knit nylon are pulled into the chain and sprocket
 - ▶ Barrier type: - material (Kevlar) used to block penetration of the chainsaw.
4. Care and maintenance
 - ▶ Some styles are washable.
 - ▶ Never sew across the fabric of leg protection that uses jamming materials as this has the effect of shortening the long jamming strands.
 - ▶ Knicks and cuts can diminish the protection.

Hardhats

1. ANSI Z133 – Head protection shall be worn by workers engaged in tree operations. It shall conform to the applicable provisions of ANSI Z89.1. Class B helmets shall not be worn when working in proximity to an electrical conductor. The tree worker shall not place reliance on the dielectric capabilities of such helmets.
2. Several styles are available with various attributes
 - ▶ Suspension style variability
 - ▶ Adjustability of headband

- ▶ Optional face protection (NOT a substitute for eye protection)
 - ▶ Optional attached earmuffs
3. Several styles are available with various attributes
 - ▶ UV light can break down the plastic and reduce protection capabilities. Hardhats should be replaced annually.
 - ▶ Never paint plastic hardhats or clean with solvents. Do not allow hardhats to be stores with fuel or bar oil.
 - ▶ Impacts can reduce future protection. Cracks can destroy protection. Inspect and replace hardhats when damaged.

Hearing Protection

1. ANSI Z133 – When it is not practicable to decrease high noise levels, or isolate workers (climbers and work crew) from it, the workers shall wear effective hearing-protective equipment as provided by the employer.
2. OSHA – Employers must supply hearing protection to workers whose time weighted average (eight hour shift) exposure is above 85 dB.
3. Hearing loss is often cumulative, and even if the time weighted average does not exceed 85dB, workers who operate chainsaws should wear hearing protection.
4. Types
 - ▶ Muff type: - Noise reduction ratings vary from 20 – 29 dB
 - When integrated with the hardhat, ear muffs can be convenient and more frequently utilized
 - ▶ Earplugs: - Noise reduction ratings as high as 38dB
 - Many form to fit ear canal

Eye Protection

1. Eye protection is required for chainsaw operation. Eye protection regulations are laid out in ANSI Z87.1.
2. Safety glasses and goggles
 - ▶ Approved eye protection will be impact resistant and offer side protection.
 - ▶ Some are tinted as sunglasses; check for UV protection.
 - ▶ Some styles will fit over eyeglasses.
 - ▶ Newer modules have anti-fog capabilities.
3. Care and maintenance
 - ▶ Minimize scratches by storing in a protective container.
 - ▶ Clean according to manufacture's recommendations.

Hand Protection

1. Hand protection is not specifically mandated for tree care operations. Employers must provide whatever protection is required to protect against specific hazards.
2. Some styles have chainsaw protection on the back of the left hand.
3. Types
 - ▶ Gloves greater dexterity than mitts
 - ▶ Mitts warmer fingers together affords greater strengths and less fatigue

Footwear

1. Although steel-toed boots are not specifically required for tree care work, toe protection is recommended for chainsaw operation. Some boots are available with synthetic hard toe protection that is not steel.
2. Some boots have chainsaw protective materials.
3. New styles are available designed with the arborist in mind:
 - ▲ No metal eyelets
 - ▲ Hardened, synthetic toe-cap
 - ▲ Lightweight
 - ▲ Flat sole for rope climbing (footlocking)

General Safety:

- ▲ Proper training: - Workers must be properly trained for their work requirements and use of equipment together with safe working procedures that must be established.
- ▲ First Aid: - There should be a very well stocked First Aid kit provided for each vehicle.
 - It is recommended that all workers receive basic First Aid training in case of emergencies.
 - Emergency phone numbers should also be available e.g. that of the ambulance.
- ▲ Potential hazards: - Workers must be aware of potential hazards on the site.
 - They must be able to identify common poisonous plants like the poison ivy.
 - They should be aware of all electric hazards, i.e. overhead / underground electric conductors, power lines communication wires must all be considered energized.
 - All direct and indirect contact must be avoided because it can lead to electric shock that can cause serious injuries.
- ▲ Fire extinguisher: - It is recommended that every vehicle must be equipped with a fire extinguisher .
 - Climbers and ground crew should know how to operate it.
 - Smoking should be prohibited when working with flammable liquid, e.g. when refueling chainsaw.
- ▲ Traffic control : - Important safety matter is traffic control for pedestrians and cars.
 - Safety cones, warning signs and flags can be used to prevent that nothing passes under the tree where work is taking place.

Chainsaw Safety:

Chainsaws are rated as the most dangerous pieces of equipment. Safe operation on the ground and in the tree requires proper training and adherence to safety procedures. Operators should always follow manufacturer's operating and maintenance instructions:

- ▶ Protective equipment and clothing, e.g. hardhats, work boots, eye and ear protection must always be worn.
- ▶ It is advisable that there should always be two persons present when working with a chainsaw in case of an emergency.
- ▶ Always engage the chain brake before starting it.
- ▶ Have a secure footing when starting the saw.
- ▶ Only drop start small chainsaws – not weighting too much in order to loose control.
- ▶ The chainsaw must be operated with two hands – never use only one hand!
- ▶ The operator should always be aware of the presence and activity of the other workers in the area.
- ▶ When carried or refueled, the chainsaw should always be stopped.
- ▶ Never operate above shoulder level.
- ▶ A common cause of injuries is kickback. It happens when the tip of the guide bar makes contact with a log or an object. The operator should be continuously aware of how he cuts because kickback occurs at a speed faster than a man can reacts.

Chainsaw maintenance : Safety

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section provide an in dept study consists of the components, starting and carburetor adjustments of chainsaw, to candidates.

Candidates credited with this are able to:

- ▶ Identify the components of a chainsaw in order to select the best saw for the operation.
- ▶ Identify the safety features of a chainsaw and explain how the work.
- ▶ Explain the concept of “kickback” and what causes it.
- ▶ Start a chainsaw safely, either on the ground or while holding it in the leg-lock method.
- ▶ Recognize when the carburetor of a chainsaw is out of adjustment, and know what to be done.

Key Terms		
throttle interlock	chain catcher pin	chain brake
leg-lock technique	inertia activated	hand guard
kickback	compression release	

- Chainsaw selection:
1. Improvements in technology
 - ▼ Lighter weight
 - ▼ More powerful
 - ▼ Reduced vibration
 - ▼ Reduced noise

- ▶ Reduced emissions
 - ▶ Reduced kickback
2. Selection criteria
 - ▶ Intended use
 - ▶ Size and weight
 - ▶ Power / RPM's
 - ▶ Handle design and balance
 - ▶ Center of gravity
 3. Top-handled saws
 - ▶ Compact and maneuverable
 - ▶ Designed for in-tree use by professionals
 - ▶ NEVER should be operated with one hand

Safety features:

1. Throttle interlock – Requires depressing a lever on the rear handle in order to depress the trigger. (The operator's handle must be locked around the handle.)
2. Chain catcher pin – If the chain jumps or breaks, the pin prevents it from coming back hard onto the operator.
3. Hand guard – The hand guard protects the operator's upper hand and also operates the chain brake.
4. Chain brake – The chain brake stops chain rotation around the bar in an instant.
 - ▶ The chain brake can be engaged manually with the hand guard.
 - ▶ Chain brakes can be "inertia activated" as may happen in the case of kickback.

NOTE: Kickback occurs when the top, upper quadrant of the bar tip comes in contact with an object, causing the chain to stop. The reactive force can cause the saw to rotate back towards the operator with the chain once and again rotating. The chain brake may be activated by the inertia of the "kick", or when the hand guard contacts the operator's wrist. Kickback occurs much faster than the operator could ever react.

- ▶ Checking the chain brake
 1. Engage using the hand guard while the chainsaw is operating at full throttle. The chain should stop immediately.
 2. To check inertia activation: While the saw is off, hold the rear handle and allow the tip of the bar to drop free about 15 inches. The chain brake should be activate. (**NOTE:** this technique does not work with all saws, especially lightweight saws and those with long bars. Check your operator's manual to see if your saw is equipped with an inertia activated brake.)
 3. The chain brake should be checked daily.

Safe starting position:

1. On the ground
 - ▶ Turn switch on (and choke out for a cold saw)
 - ▶ Press compression release button, if present
 - ▶ Engage chain brake
 - ▶ Left hand on top handle with thumb around and wrist locked
 - ▶ Secure rear handle with foot or knee
 - ▶ Pull starter cord in direct line with starter assembly.

2. Leg-lock technique

- ▲ Turn switch on (and choke out for a cold saw)
- ▲ Engage chain brake
- ▲ Left hand on top handle with thumb around and wrist locked
- ▲ Lock rear handle behind right knee
- ▲ Pull starter cord in direct line with starter assembly.

3. Cold engine starting

- ▲ Pull the choke lever out and proceed with starting instructions until the engine “pops”.
- ▲ Push the choke lever in and pull starter cord until engine starts.
- ▲ Throttle down to idle to reduce RPM's.

NOTE: Some saws are equipped with a compression release button that releases cylinder compression, making the cord easier to pull and reducing wear on the starter system. Also, chainsaws are easier to start if the carburetors are adjusted properly.

Carburetor adjustment: If the carburetor is not adjusted properly the saw will be difficult and / or unsafe to start. The carburetor supplies the engine with the appropriate mixture of vaporized fuel and air. Some saws have fixed jets that do not require operator adjustment. Others have limited adjustment jets.

5 STEP CHECK:

1. Make sure the air filter is clean.
2. Balance the high (H) and low (L) rpm screws to manufacturer's specifications. Warm up the saw and run at top speed and listen for a flutter or “4 stroking” sound. Turning the H screw clockwise will reduce the fuel mixture, making the saw “scream”. From this point gradually turn the screw counter-clockwise until the flutter point is reached. **Note:** Running the saw on a fuel mixture that is too lean will ruin the engine.
3. Let the saw come to idle and check that the chain stops rotating. If the chain is still spinning, turn the throttle (T) screw counter-clockwise until the chain does not rotate while the saw idles.
4. Engage the chain brake . Rotate the saw to check that it runs in all positions. If the saw stalls then it is getting too much fuel, which is paddling below the cylinder. Turn the (L) screw clockwise a little, then repeat the test.
5. Release the chain brake. Throttle up the engine. If it hesitates, then the saw is not getting enough fuel. Turn the (L) screw counter-clockwise and repeat the last two steps until the saw runs as desired, or take it to the dealer.

Chainsaw maintenance and safe working procedures

Level:

Credit:

Expiry date:

Field:

Arboriculture and Urban Forestry

Sub field:

Forestry

Objectives:

This section provides knowledge to candidates which will allow them to operate a chainsaw by concentrating on the engine and drive system.

Candidates credited with this are able to:

- ▲ Explain the importance of proper chainsaw maintenance.
- ▲ Perform a daily inspection of the working components of a saw.
- ▲ Be familiar with the starting system and drive system of a chainsaw.
- ▲ Explain the importance of using the proper fuel mixture in a chainsaw.

Key Terms		
sprocket	floating rim sprocket	spur sprocket
clutch	anti-vibration mounts	cylinder fins
chain catcher pin	starting system	drive system
air filter	throttle interlock	chain brake

Daily Inspection:

1. air filter
 - ▼ clean by lightly tapping, brushing or using forced air
 - ▼ may need to use warm, soapy water occasionally
 - ▼ NEVER use fuel or other solvents to clean – the fuel may break down the filter, and will attract dirt.
2. throttle interlock
 - ▼ must depress in order to depress trigger
 - ▼ check for proper operation
3. trigger
 - ▼ check for proper operation
 - ▼ should require depression of the throttle interlock
4. choke lever
 - ▼ check for proper operation
5. on / off switch
 - ▼ check for proper operation
6. chain brake
 - ▼ stop chain rotation instantly
 - ▼ check manual operation
7. chain catcher pin
 - ▼ stop the chain if it jumps off or breaks
 - ▼ make sure it is present and undamaged
8. look for cracks
 - ▼ cracks in the assembly may lead to vibration
 - ▼ excessive noise
 - ▼ loose screws

NOTE: Within the first 100 hours, it is important to check that the screws on the chainsaw are all tight. Screw can vibrate out leading to other problems.

Starting System:

1. Check the starter cord for frays.

2. Check that the flywheel turns when pulling the cord. Check that the starter engage.
3. Do not pull the cord at an angle against the housing. This can cause excessive wear on the rope and starter assembly.
4. Be sure the cord returns all the way in. Do not let it slap.
5. The tension of the starter pulley can be adjusted. If it is too tight the spring may break.
6. If the starter cord is too short, the saw will be harder to start and the starter pulley may break.
7. When installing or adjusting the pull cord, make sure there is still play in the starter spring when the cord is pulling all the way out.

Drive System:

1. Check that the clutch, chain brake components, bar pad and socket are all clean and free of debris.
2. Check that the oil hole is clear and operating properly.
3. Gently blow or lightly brush sawdust from the cylinder.
4. Assure that the anti-vibration mounts are tight. Loose mounts will produce excessive vibration which can in turn reduce efficiency and saw control while adding to operator fatigue.
5. Make sure the chain brake band is clean.

Sprocket:

1. Spur sprocket
 - ◀ easier to put chain on
 - ◀ change when wear becomes apparent
 - ◀ used on smaller saw, with shorter bar and lower power requirements
 - ◀ Excessive wear will reduce the effective life of bars and chains
2. Floating rim sprocket
 - ◀ used on bigger saws with longer bars
 - ◀ independent of clutch drum
 - ◀ excellent transfer of power
 - ◀ replaced inexpensively, may require frequent replacement
 - ◀ Excessive wear causes excessive bar and chain wear, increased vibration, and reduced efficiency

Drive System:

1. Check that the clutch, chain brake components, bar pad and sprocket are all clean and free of debris.
2. Check that the oil hole is clear and operating properly.

Fuel Mix:

1. Always consult your Owner's Manual for the proper fuel mix. Do not vary the fuel mix from the recommended ratio.
2. Use the manufacturer's recommended types of oil mix in the fuel. Some oil mixes are not suitable for chainsaw use (i.e. outboard motor oil mix).
3. It is best to use fresh fuel since gasoline can lose its octane rating over time. Some oil mixes contain a fuel stabilizer to minimize this problem.

Chainsaw Maintenance: Bar Maintenance and Sharpening

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section provides knowledge to candidates which will allow them to explain, understand and apply bar maintenance and sharpening.

Candidates credited with this are able to:

- ▶ Explain the differences between bar types, and the advantages and disadvantages of each.
- ▶ Become familiar with standard bar maintenance procedures.
- ▶ Explain and discuss the various types of chains and cutters that are available for chainsaws.
- ▶ Understand chainsaw-sharpening techniques including how to take down the depth gauges.

Key Terms		
Laminate bar	solid bar	rails
Connecting links	groove	oil hole
Bar pad	sprocket nose	viscosity
Pitch	gauges	drive link
Cutting teeth	depth gauges	low kickback

Chainsaw Bars:

1. Laminate bars
 - ▶ Three separate sheets of metal
 - ▶ High grade metal outer rails- durable
 - ▶ Lightweight
 - ▶ Used on smaller saws with bars 20" or less
2. Solid bars
 - ▶ Single sheet of metal with cut groove
 - ▶ Metal less durable on outer rails
 - ▶ More flexible
 - ▶ Optional replaceable tip
 - ▶ Used for longer bars

Bar Maintenance:

unevenly.

1. Inspect the rail
 - ▶ Should be flat and straight to prevent the chain from rocking or running unevenly.
 - ▶ Be sure the rails are not spayed (splitting apart) .
 - ▶ available for chainsaws.
 - ▶ Be sure there are no burrs.
 - ▶ down the depth gauges.
2. Clean the groove
 - ▶ Metal dust and shavings can cause premature wear.

- ▶ When hot, debris can become baked on.
 - ▶ Remove sawdust and other debris.
3. Clear the oil hole
 - ▶ It is imperative that the oil hole be clear for proper lubrication.
 - ▶ Be sure the bar pad is cleaned off and seated properly.
 4. Check for wear
 - ▶ Wear on the top / back and bottom / front of the bar can indicate a loose chain.
 - ▶ If the saw is run with the chain too loose, it may be bypassing the oil hole and not picking up oil.
 - ▶ Bars with excessive wear should be replaced to avoid ruining chains and sprockets.
 5. Check the sprocket nose
 - ▶ Assure that the sprocket is rotating freely and getting sufficient lubrication.
 6. What about greasing?
 - ▶ Some bar tips are equipped with a grease fitting.
 - ▶ Tips should be greased frequently and generously or not at all, allowing the bar oil to lubricate the tip.
 - ▶ Occasional grease to become an abrasive paste.
 7. Bar oil
 - ▶ High viscosity oil required (high tack / low sling). Use only chainsaw bar oil.
 - ▶ Oil must be pure and clean.
 - ▶ Never use used motor oil. The viscosity will be too low and it may be abrasive.

Chains:

1. Sizes
 - ▶ Pitch - to measure, take the distance between three rivets and divide by two size must match sprocket size.
 - ▶ Gauge – it is the thickness of the drive link where it fits into the bar groove.
 - must match bar groove width common gauges: .050", .058", .063"
2. Types
 - ▶ Many types ranging from consumer chains to professional chains, various design of cutting teeth and various design of depth gauges.
 - ▶ Consumer chains; low kickback; performance not as good
 - ▶ Professional chains; high performance; less kickback
3. Inspection
 - ▶ Check that the chain sits properly in the groove and runs smoothly along the rails.
 - ▶ Check the rivets on the connecting links.
 - ▶ Excess wear on the heel and toe of the “runners” can cause excessive wear on the bar.
 - ▶ The chain should be tensioned so that it is taut, but it should rotate freely.

- Five Parts of a cutting tooth:
- ▲ 1. depth gauge – sets up thickness of cut
 - ▲ 2. point – starting point of cut
 - ▲ 3. top plate – cuts through wood fibers
 - ▲ 4. side plate – cuts through wood fibers
 - ▲ 5. chisel – should be at 45 degrees as it enters the wood

- Sharpening:
1. The angles of each part of the tooth must be sharpened correctly. Follow manufacturer's recommendations.
 2. With today's high performance, low tolerance chains it is best to utilize sharpening devices rather than simply relying on a flat file and "eyeballing" it.
 3. The depth gauges must be brought down as the teeth are sharpened. If the depth gauges are out of balance with the teeth the result may be:
 - ▲ Increased vibration and "bouncing"
 - ▲ Increased wear on the chain, bar and sprocket available for chainsaws.
 - ▲ Reduced performance
 4. The optimum sharpening would have the depth gauges individually tuned to each tooth. Then each tooth could be a different length.
- NOTE:** Always wear gloves when working on a chainsaw chain.

Chainsaw maintenance: Notches, Hinges and back Cuts

Level:

Credit:

Expiry date:

Field: Arboriculture and Urban Forestry

Sub field: Forestry

Objectives: This section provides knowledge to candidates which will allow them to explain, understand and apply bar maintenance and sharpening.

Candidates credited with this are able to:

- ▼ Explain the reactive forces that can result when using a chainsaw. disadvantages of each.
- ▼ Identify the starting corner and the kickback quadrant of the bar of the chainsaw.
- ▼ Compare and contrast notch types and sizes. available for chainsaws.
- ▼ Understand how the hinge work in tree felling.
- ▼ Explain the bore cut technique of back cutting and its advantages.

Key Terms		
Reactive force	starting corner	kickback
Hinges	notch	bypass
Back cut	bore cut	felling plan
Kickback quadrant		

Review of PPE:

Personal Protective Equipment

- ▲ Hardhat
- ▲ Eye protection
- ▲ Hearing protection
- ▲ Leg protection
- ▲ Foot protection

Reactive Forces:

- ▲ 1. Pull – When the chainsaw operator is cutting with the bottom part of the bar, the saw tends to pull away from the operator and into the cut.
- ▲ 2. Push – When the operator cuts with the top of the bar, the saw tends to push back toward the operator and out of the cut.
- ▲ 3. Kickback – Anytime the front, upper quadrant (kickback quadrant) of the tip of the chainsaw bar contacts an object, the chainsaw reacts by rotating back toward the operator.

Safe Chainsaw Use:

- ▲ Stand with your feet firmly planted.
- ▲ Always operate your chainsaw with both hands. Your left hand should be on the upper handle with your thumb wrapped around the handle bar.
- ▲ Use your body to brace against the back of the saw when practical.

Starting corner:

The starting corner is the bottom of the tip of the bar. When making a bore cut, always start cutting into the wood with this part of the bar to avoid kickback. Start cutting with the saw at full throttle.

Notches:

- 1. Angle
 - ▼ 45° - Sometimes referred to as the common notch or the traditional notch. A limitation of this notch is that the tree or section of wood will still be at 45 degrees when the notch closes. When the notch closes, the tree must stop falling or the hinge must break. At this point the operator has lost control. Side lean, gravity, wind and other factors are now in control.
 - ▼ 70°- 90° - This open face notch allows the worker to take full advantage of the hinge, with a greater degree of control because the hinge doesn't break until the tree is almost on the ground.
- 2. Depth rules of thumb
 - ▼ Traditional rule of thumb: The notch should be one-third the depth of the tree (section) being cut.
 - ▼ Percent of diameter method: The length of the hinge should be 80-100% of the diameter of the section being cut. This will vary since many trees are not round in cross section. The length of the hinge determines the depth of the notch.
 - ▼ Avoid cutting the notch deeper than 50% of the diameter of the section.

3. Cut the top first

- ▶ Line up the top cut while bracing your body against the tree and facing the desired felling direction.
- ▶ Some chainsaws have sighting lines on the saw casing to help line up the face notch.
- ▶ Avoid placing the notch where there are cracks or decay, if possible.
- ▶ Use the upper cut as a sight through which to line up the lower cut and avoid sawing too far.

4. Bypass

- ▶ It is very easy to bypass the apex of the notch when making the cuts.
- ▶ Bypassing cuts into the crucial fibers of the hinge and should be avoided.
- ▶ Bypassing cuts can reduce the effectiveness of the hinge, or render it useless.
- ▶ Avoid bypass cuts in the notch by sighting through the top cut and checking both ends of the notch frequently while cutting.

The Hinge:

- ▶ Function – The hinge “steers” the tree in the desired direction of fall. If the hinge is the proper thickness then the wood fibers will break when the face notch closes.
- ▶ Thickness – A rule of thumb for felling trees is to allow a hinge that has a thickness of 10% of the tree’s diameter. Flexibility in this guideline is in order. For example, when cutting short sections, a 10% hinge may be too much for the climber to break off with limited leverage.
- ▶ Proper use – A skilled operator will use the hinge to his or her advantage depending on the felling conditions
 - On larger diameter trees, it may be necessary and beneficial to reduce the hinge thickness from the 10% rule of thumb.
 - Avoid cutting into the hinge when making the back cut.

The Back Cut:

1. Traditional, straight back cut

- ▶ Cut from the back toward the notch.
- ▶ The hinge is formed as the back cut approaches the notch.
- ▶ It is easy to cut through the hinge while making the back cut, especially if the sawyer is looking toward the top of the tree
- ▶ When using the common (traditional 45 degree) notch, it is necessary to make the back slightly higher than the apex of the notch to help prevent the tree from kicking back toward the operator. This is sometimes referred to as a stepped back cut.

2. Bore cut

- ▶ Bore cut into the tree (several inches) behind the apex of the notch. Be sure to start the cut with the starting corner of the chainsaw bar. Start the cut well behind the desired position of the hinge then, once in, carefully cut to the desired thickness of hinge.