

Pruning

Third Edition



Best Management Practices

Companion publication to the ANSI A300 Part I:
Tree, Shrub, and Other Woody Plant Maintenance
– Standard Practices, Pruning

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Tree Pruning

Third Edition

Sharon J. Lilly, Edward F. Gilman, & E. Thomas Smiley

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– Standard Practices, Pruning



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Purpose

Professionals in the field of arboriculture established committees in the United States, the United Kingdom, and Germany to develop standards for tree maintenance designed to provide a more uniform level of service and to help ensure public safety. The U.S. committee, working under the auspices of the American National Standards Institute (ANSI), developed standards for pruning, planting, support systems, risk assessment, and other aspects of tree care. *The American National Standard for Tree Care Operations—Tree, Shrub, and Other Woody Plant Management—Standard Practices* (ANSI A300) was written to provide minimal performance standards for work practices and writing specifications.

The International Society of Arboriculture (ISA) has developed companion publications known as *Best Management Practices* to aid in the interpretation and implementation of ANSI A300 standards and to provide guidance to practitioners. These publications are intended as guides for practicing arborists, tree workers, their supervisors, and the people who employ their services.

Because trees and shrubs are unique living organisms, not all practices can be applied to all trees. It is important that contracts and specifications developed using these guidelines and the ANSI A300 standards are written or reviewed by a knowledgeable arborist. Departures from the standards should be made with careful consideration of the objectives and with supporting rationale.

This BMP is the companion publication to *ANSI A300 Part 1—Tree, Shrub, and Other Woody Plant Management—Standard Practices, Pruning* (2017). Root pruning standards are included in *ANSI A300 Part 8, Root Management*, and its companion publication the ISA *Best Management Practices: Root Management*.

Introduction

This *Best Management Practice* is intended to assist arborists to achieve industry standards and meet client expectations when pruning trees and shrubs. It provides reasons why pruning is undertaken; explains pruning systems and amounts; provides background and instruction on pruning cuts; reviews sample specifications; and comments on timing of these operations. Experience and observation teach the truth in Alex Shigo's observation: "Pruning is one of the best things an arborist can do for a tree but one of the worst things we can do to a tree." Pruning is a double-edged sword, either helping or hurting—depending on where, when, how, and why it is applied.

Pruning that is well executed results in a variety of benefits, including: reduced likelihood of whole tree, branch, and stem failure; appropriate (or required) clearance for utilities, buildings, vehicles, and pedestrians; improved health and appearance; and enhanced view. When poorly performed, pruning can harm the tree's health, stability, and appearance. Negative consequences can also occur when pruning is not performed at all (Figure 1).

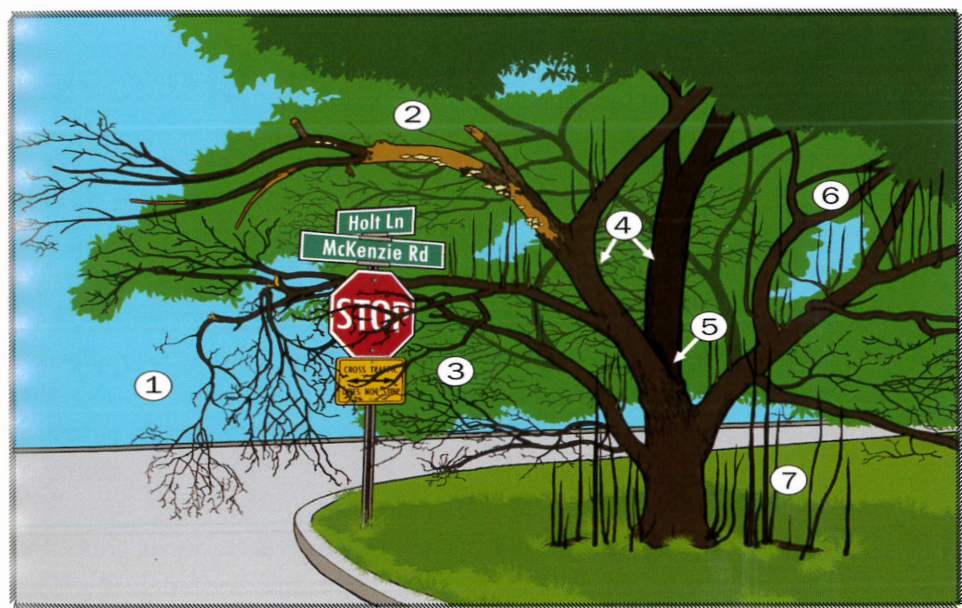


Figure 1. Several consequences can occur when pruning is not performed at all. These consequences include: 1) an accumulation of broken branches; 2) dead branches; 3) branches that interfere with site function; 4) weak, codominant stems; 5) defects such as included bark; and in some species, development of 6) watersprouts; and 7) suckers.

These consequences include development of branches that interfere with people or structures; weak, codominant stems; defects such as overextended branches; and accumulation of dead branches. In a forest these conditions may not be a concern, but in an urban environment they can pose risks to public safety, can threaten the health of trees, and may become unsightly. It is best to prune trees when they are young to establish strong branch architecture. Young trees can readily respond to pruning wounds. Reducing or removing diseased, infested, or broken branches is a common practice on mature trees. Often trees must be pruned when they are mature to reduce the likelihood of live or dead branch failure, whole tree failure, or to mitigate interference with infrastructure, buildings, other plants, or human activities.

Pruning live branches reduces a tree's capacity to photosynthesize and manufacture sugar. Pruning also creates wounds the tree must expend energy to close and defend. Therefore, the costs and benefits of pruning healthy branches should be assessed when developing pruning objectives. Routine live-branch removal does not improve tree health, and some practices, such as lion-tailing, can have adverse effects on tree health and can increase the likelihood of branch failure.

Inspection

Prior to beginning any pruning operation, an arborist or qualified professional should visually inspect the plants to be pruned and understand the client's desires. Inspection should include:

- general condition/branch architecture/health,
- identification of the type of branches to reduce or remove (e.g., dead, overextended, interfering, needing clearance) and location (e.g., over house, under wires),
- amount of branches to be removed or reduced (number, diameter, or percentage),
- type of cuts to use (branch removal, reduction, heading, or shearing),
- signs of wildlife nesting, and
- worker safety concerns (e.g., root collar buried, powerlines, bees, tree defects).

This inspection should be the basis for establishing the objective and writing the proposal or specifications for work. In addition, the observation can be used to develop a job site safety analysis as specified by ANSI Z133 or other local regulations.

Arborists should be aware of national and local wildlife regulations and should strive to remain in compliance. Most birds and endangered species are protected from disturbance, and violators may be subject to significant penalties. When pruning during the spring and summer, check trees and shrubs for any signs of wildlife nests. Examine holes and cavities for woodpeckers, owls, and other cavity-nesting animals. If nests are present, do not disturb them. It is best to return at a later date to complete the work. If that is not possible, avoid disturbing the portion of the tree that contains the nest.

Working arborists arriving on the job site should conduct another inspection of the tree before entering it. If conditions are found that are not consistent with the initial inspection, they should be reported to a supervisor and/or the client and appropriate measures should be taken to mitigate the risk or amend the scope of work.

Pruning Systems

One of the overarching factors to consider prior to pruning trees or shrubs is the pruning system that will be applied. The pruning system defines the desired long-term form of the plant. In choosing a pruning system, the style and design of the landscape plus the client's goals need to be considered. The landscape design may be formal, semiformal, or informal. Often landscapes are a mixture of styles (e.g., formal at the entry to a building and informal on the periphery of a property). Various pruning systems have been used in arboriculture, fruit production, and landscaping; they include natural, topiary, pollard, espalier, pleach, fruit production, and bonsai.

Natural

The natural pruning system is an informal style used to retain and promote the characteristic form of the species or cultivar in its current location (Figure 2).

Arborists pruning street, landscape, and forest edge trees typically focus on the plant's natural form. Within this system, however, trees are often pruned to coexist with people and the urban environment, so trees may not have a completely natural appearance as they would have in an open field. Pruning within the natural system may involve branch removal and/or reduction that can alter the form of a tree to avoid conflict with infrastructure, encourage strong architecture, allow desirable views, and provide clearance.

The pruning interval for the natural system is often longer than that of other systems. The natural system may require re-pruning every one to five years, while other systems may require re-pruning every few months or annually.



Figure 2. The natural system retains the characteristic form of the species, often with variations needed to avoid conflicts.

Topiary

Topiary is a formal pruning system in which shrubs, vines, or trees are pruned into a specified shape by shearing and/or pruning (Figure 3).

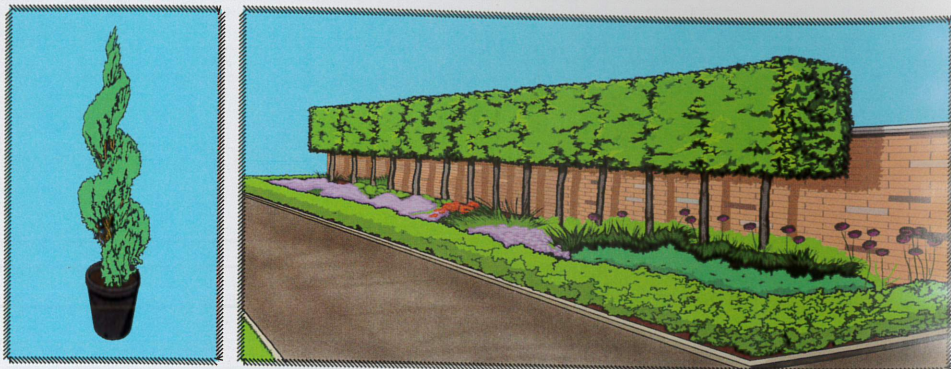


Figure 3. Topiary is a formal pruning system in which plants are pruned to the desired shape such as the spiral topiary (left) or aerial hedge (right).

Hedges and geometrically shaped trees and shrubs are forms of topiary. Sheared hedges and foundation plantings are common in urban and suburban landscapes. Topiary pruning is also used to create artistic forms and shapes, though this is usually reserved for high-visibility sites, specimen plantings, and formal landscapes.

The plant species that work best for this system are typically slow-growing, small-leaved evergreens. Species with fast growth rates require a shorter pruning interval. Growth regulators may be used on some species to extend the pruning interval.

Pollard

Pollarding is used to maintain trees in a certain size range, often with a semiformal appearance (Figure 4). Pollarded trees can live as long as or longer than trees maintained with the natural system.

Pollarding historically was used to generate epicormic sprouts for fuel, shelter, fodder, and other products, at a height where grazing animals could not reach them.

This type of pruning is primarily applied to deciduous trees that are known to tolerate this system (Table 1). Pollarding is not the same as the unacceptable

practice of topping. Topping is the reduction of tree size by heading many or most large, live branches and leaders, without regard to long-term tree health or structural integrity.

Pollarding is a long-term process that involves heading followed by regular sprout removal. The process is usually started on young trees with heading cuts made on stems and branches that are about three years old. Heading older branches may kill or start the decline of some species. After these cuts, no additional heading cuts should be necessary. The tree should respond to the heading by producing an abundance of sprouts just below the cut surface.



Figure 4. Pollarding is a semi-formal pruning system. After years of sprout removal, pollard heads develop at the end of the branch.

Generally, all of these new sprouts are removed on an annual basis. However, the pruning interval can sometimes be extended up to three years, depending on species, climate, growth rate, and objectives.

After a few pruning cycles, pollard heads (also called knobs or knuckles) develop, and the tree produces sprouts primarily from these knobs. Knobs function in compartmentalization to reduce decay movement down the stems and branches. Sprouts that grow from knobs should be removed during the dormant season, taking care not to cut into or below the knobs. The knobs are the key differentiating factor between pollarding and topping. If knobs are damaged or removed in subsequent pruning, the cut branches react as they would on a topped tree. Once trees are pollarded, they usually should be maintained as pollards.

Table 1. Some species in these genera are known to tolerate pollarding.

Ash (<i>Fraxinus</i>)	Beech (<i>Fagus</i>)
Catalpa (<i>Catalpa</i>)	Crapemyrtle (<i>Lagerstroemia</i>)
Elm (<i>Ulmus</i>)	Coraltree (<i>Erythrina</i>)
Hawthorn (<i>Crataegus</i>)	Horsechestnut (<i>Aesculus</i>)
Japanese quince (<i>Chaenomales</i>)	Linden (<i>Tilia</i>)
Maple (<i>Acer</i>)	Oak (<i>Quercus</i>)
Pear (<i>Pyrus</i>)	Plane tree (<i>Platanus</i>)
Sweetgum (<i>Liquidambar</i>)	

Espalier

Espalier is a formal system for developing plants in a two-dimensional plane, such as along a wall or a fence (Figure 5).

This type of pruning was developed to maximize use of space and to create a visual effect. Sometimes fruit trees could be grown outside their natural hardiness range by growing them against south-facing walls (north-facing walls in southern hemispheres). The system is also used in commercial grape and modern apple production to promote uniform ripening, easier pesticide application, and easier harvesting.

Espalier is developed by selectively pruning branches and tying twigs to a vertical framework. Branches that do not fit the desired form are removed when they are small. As the espaliered plant matures, ties are removed or replaced to prevent girdling.



Figure 5. Espalier is a formal system for developing plants in a two-dimensional plane.

Pleach

Pleaching is a system that involves interweaving branches horizontally, to form an arbor, wall, allée, or arching tunnel.

This is usually accomplished using multiple plants and pruning, weaving, and tying branches together to create the desired effect. Pleaching, like espalier and topiary, requires frequent pruning and management to maintain plants in the desired form. The frequency of maintenance depends largely on the species, growth rate, climate, and intricacy of the design. Branches that do not fit the desired form are removed or bent when they are small. As the pleached plants mature and branches graft or grow together, ties are removed or adjusted to prevent girdling.

Fruit Production

There are numerous subsystems used in the commercial production of tree fruit. These systems are specific to the tree species, but the intent of all of them is to maximize fruit production. Examples of subsystems include central leader, modified central leader, bi-axis, espalier on a trellis, slender spindle, vertical axis, and open-center. Fruit tree pruning is not within the scope of this publication, but many publications are available on this topic.

Bonsai

Bonsai is a general term for a system that maintains container-grown trees at a small size. It is based on the Chinese *penjing* and the Japanese *bonsai* art forms for miniature, containerized trees.

In arboriculture, this system is intended mainly for trees that have confined root space, where a natural form is desired, and where the tree is to be maintained at a fixed or limited size.

Bonsai trees are maintained by regular leaf, twig, and root pruning, sometimes with the application of growth regulators. A detailed description of bonsai pruning is outside the scope of this publication, but there are many publications available on this topic.

Pruning Objectives

No tree should be pruned without a clearly defined objective. The objective is often determined by discussing with the client what they want to achieve with the pruning. Establishment of objectives must consider pruning system, plant health, growth habit, plant size, structure, species characteristics, expected growth response, client expectations, location, and site usage. After considering the above, a specification should be developed that states one or more pruning objective(s).

The most common and important objectives are described here along with guidelines for implementation. These objectives serve as examples and can be expanded or shortened to account for site conditions and expectations. Removing the correct stems and branches to accomplish specified objectives is as important as making correct pruning cuts. Even with good pruning cuts, if the wrong branches, too few branches, or too many branches are removed, nothing of merit is accomplished.

Improving Structure

Trees that have branch architecture or structure that is compatible with their site and intended use will provide more benefits for a longer time. Pruning can improve tree structure by establishing a trunk larger in diameter than all branches. In addition to developing strong architecture, structural pruning can promote or discourage branch growth in a certain direction (directional pruning). This can help minimize future interference with people, traffic, lines-of-sight, powerlines, buildings, lighting, or other plants. Structural pruning should be performed on young and semimature trees. Young trees have a larger proportion of sapwood, which results in plentiful energy reserves and the ability to quickly close pruning wounds.

Excurrent species will naturally tend to develop one dominant leader, unless codominant stems arise from injury or other causes. In contrast, species with a decurrent form usually do not develop a dominant leader in the landscape unless pruned to develop that structure.

Trees that are planted in clumps or that have a multistemmed natural growth habit can be maintained with several trunks where this shape fits the location. Moreover, even excurrent species may become decurrent over time.

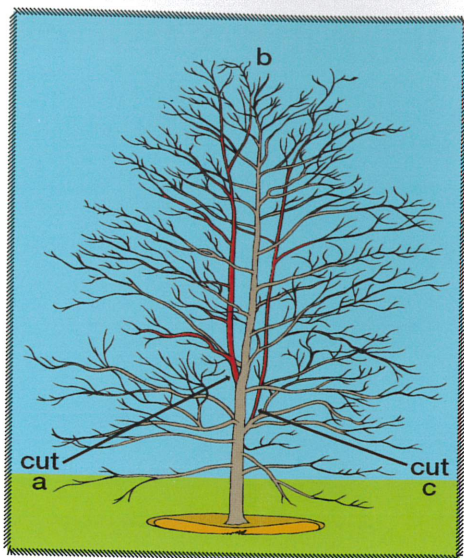
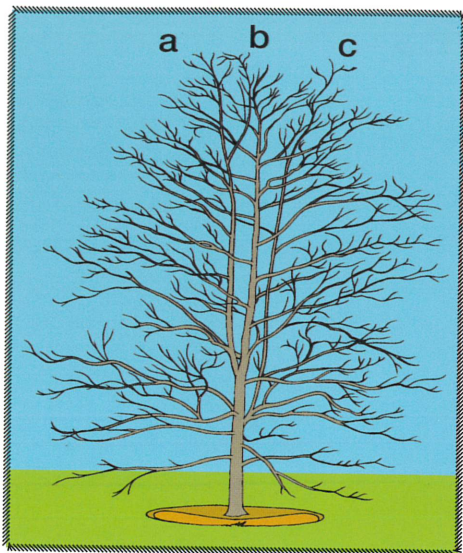
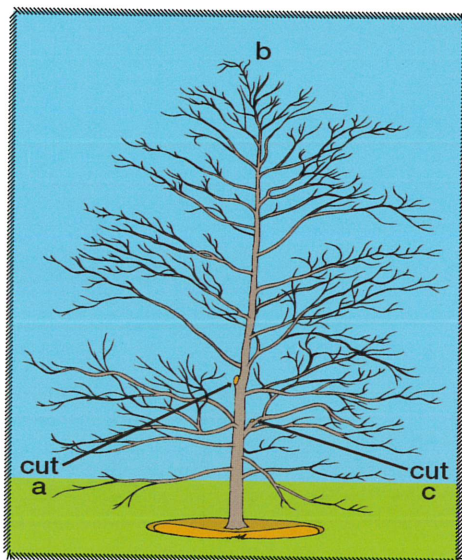


Figure 6. Pruning to improve structure is a common objective. On this young tree, a competing codominant stem (a) and a large lateral branch (c) were removed at their points of attachment (cut a and c) to clearly define the dominant leader.



For most tree species, the first step in structural pruning is to identify and establish one dominant leader. The dominant leader is the main stem that is or has the potential to be the tallest growing point. This leader is typically near the center of the crown, but it may be off-center to direct future growth away from a powerline

or other obstruction. Stems and branches that are taller than or nearly as large in diameter as the desired dominant leader are reduced in length (subordinated) or removed (Figure 6).

Removal of these competing stems is the preferred option on small trees, especially those that may not be pruned again in the foreseeable future. Subordination is preferred when a minimal change in appearance is

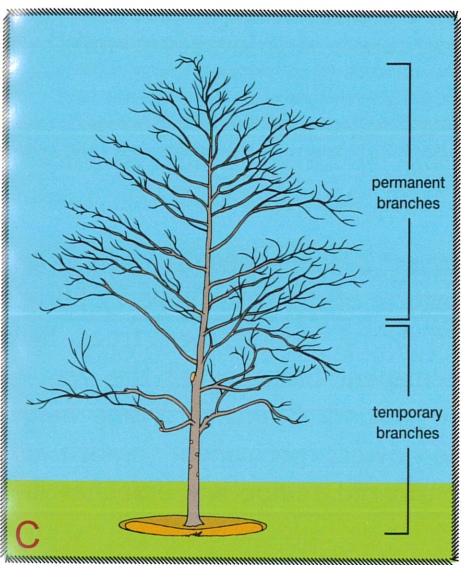
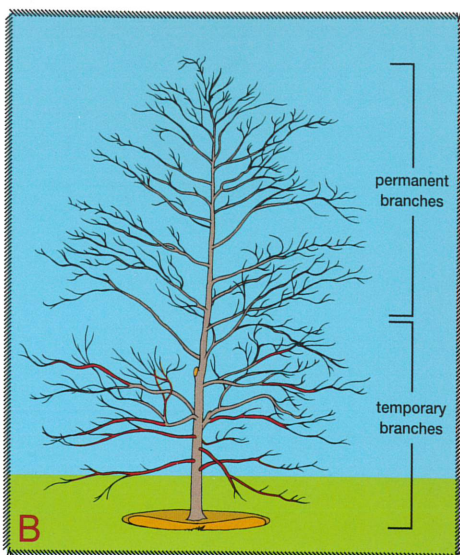


Figure 7. The second step to achieve the objective of improving tree structure is to define the permanent and temporary lower branches. Temporary lower branches are removed or reduced at each pruning interval. Eventually, they will be removed completely. (A) Before; (B) Planning which branches to prune; (C) After pruning.

important and the tree will be pruned on a regular basis, or if removal of the problem stem will produce a large wound that is likely to promote decay in the remaining branch or trunk. Competing stems that have been reduced can be retained for a long time, or they can be removed later, if necessary.

Reducing larger-diameter competing stems results in less decay potential in the parent stem than removal. To minimize the need to make large-diameter cuts, a short pruning interval (increased pruning frequency) and multiple prunings over a period of five to twenty years may be required.

The second step in structural pruning is the identification of the lowest permanent branches (Figure 7). The height of these branches from the

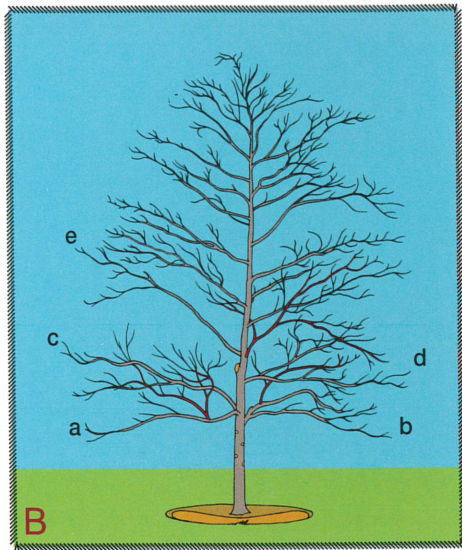
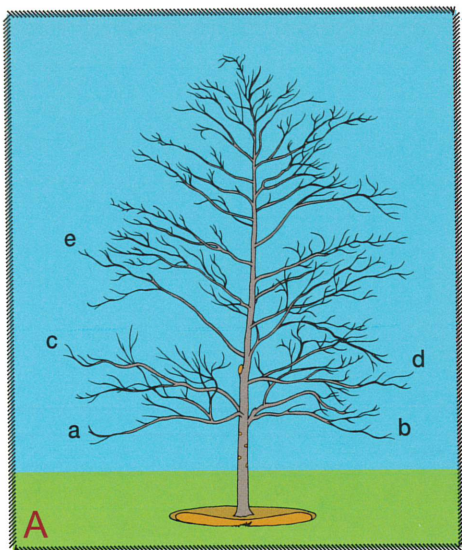
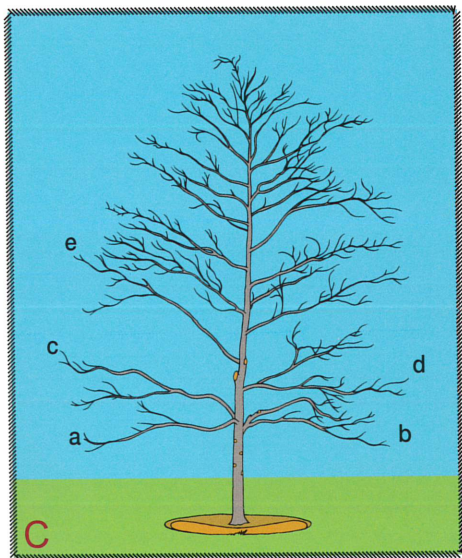


Figure 8. The third step to achieve the objective of improving tree structure is to remove or reduce branches that are arising too close to an adjacent branch and may interfere with future tree development. Here, the highlighted branches are removed to provide better vertical spacing. In future pruning cycles, branches *a* and *b* will also be removed. (A) Before; (B) Planning which branches to prune; (C) After pruning.



ground is dependent on location and function of the tree (Table 2). Shrubs and some open-grown trees have permanent branches all the way to the ground. Branches arising below the lowest permanent branch are considered temporary branches and should be reduced in length so they

don't shade and interfere with the permanent branches; they should all be removed over time. In the short-term, temporary branches can be retained or reduced to promote growth and trunk taper development and to protect the trunk.

The third step is to begin establishing permanent tree architecture by considering vertical spacing of scaffold branches. Scaffold branches are the main outward/upward-growing branches on which other branches will

develop to define the tree's crown.

Sustainable scaffold branches are those that are:

- located high enough aboveground to become a permanent part of the tree,
- strongly attached to the trunk,
- free of serious defects such as included bark, cracks, large wounds, and sharp bends,
- among the largest on the tree but less than the trunk diameter measured above the union,
- growing in a radial direction, outward from the stem, and
- appropriately spaced vertically apart.

A guideline for vertical spacing is about 8 inches (20 cm) for smaller trees and 18 to 24 inches (45 to 61 cm) or more for large-maturing trees, although this guideline varies with tree maturity and among species.

Spacing is established by reducing or removing competing stems or branches (Figure 8). Scaffold selection can take ten years or more depending on climate, species, and location.

During the structural pruning process, broken, dead, diseased, or damaged branches are typically removed, whereas the largest and competing branches are reduced. These three steps should be considered and can be performed at each pruning interval.

Table 2. Typical clearance distances as measured from the object or area of concern to the branch.

<i>Object or area of concern</i>	<i>Typical clearance distance</i>	
Sidewalk clearance	8 ft	2.4 m
Residential street clearance	14 to 18 ft	4.3 to 5.5 m
Arterial road (bus or truck route)	15 to 20 ft	4.6 to 6 m
Residential roof	6 ft	1.8 m
Building side clearance	3 ft	0.9 m

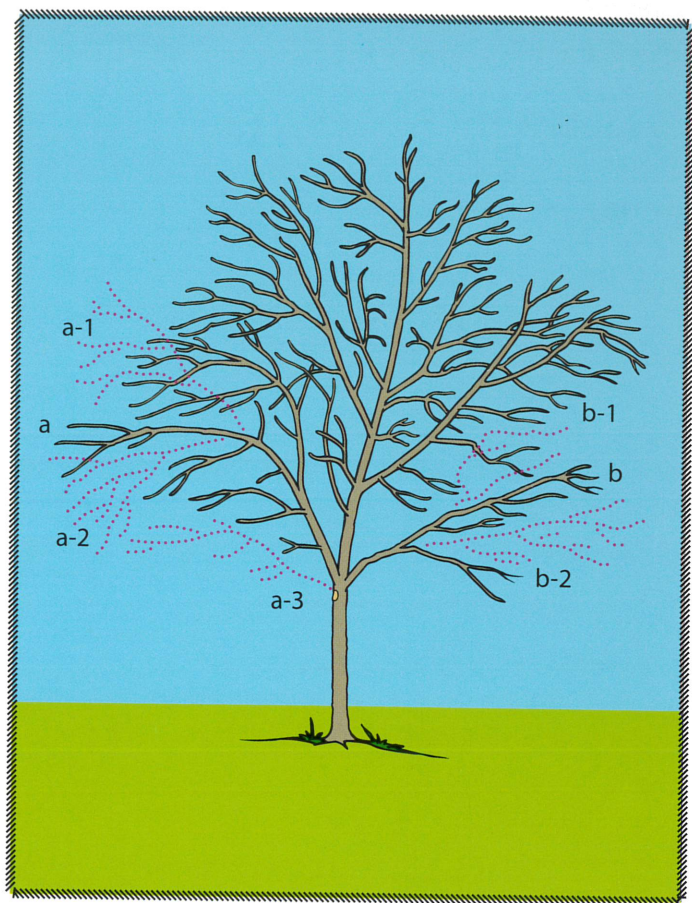


Figure 9. To achieve the objective of providing clearance, lower (temporary) branches are removed at the trunk (a-3) or reduced (a-1, a-2, b-1, b-2) to lighten their weight so they will spring upward.

Risk Mitigation Pruning (Reduce Likelihood of Failure)

Pruning to reduce the likelihood for branch or whole tree failure should be a primary consideration for large trees in urban areas. Branch, stem, and whole tree failures are influenced by many factors including species, defects or conditions, site conditions, loads, size, and response growth (see ISA's *Best Management Practices: Tree Risk Assessment*). Conditions and defects to consider for risk mitigation pruning are presented in Table 3 and Table 4.

The best way to reduce likelihood of failure in the future is to routinely structurally prune trees when they are young through middle age to develop strong architecture. As trees grow larger and branch architecture is established, risk mitigation has a different emphasis. To reduce the likelihood

of trunk and root failure, it may be necessary to reduce the height and/or spread of the entire crown or certain sections of it. In some cases, whole tree removal may be the only option to reduce the likelihood of whole tree failure to an acceptable degree. The choice among these depends on the tree, site, and the type and consequence of failure.

When pruning trees that drop large fruit, removal of the fruit or developing inflorescence may be included in risk mitigation pruning. Examples of these species that produce large fruit include: osage orange (*Maclura pomifera*), coconuts (*Cocos nucifera*), Coulter and Bunya pines (*Pinus coulteri* and *Araucaria bidwillii*), and some tropical fruit trees.

Topping trees as a means to reduce height and/or spread is considered an unacceptable practice, as it causes decay, the development of branches with poor attachment to parent branches, and greater likelihood of branch failure.

Table 3. Some defects and conditions that increase the likelihood of branch failure that can be mitigated by branch removal or reduction include branches that are:

- | | |
|--------------------------------------|--|
| • dead | • dying |
| • diseased | • cracked |
| • decayed | • broken or detached |
| • hanging | • excessively long |
| • large in diameter (>50% of parent) | • outside of the normal shape of the crown |

Table 4. Some conditions that may increase the likelihood of trunk or root failure are:

- | | |
|----------------------|-------------------------------------|
| • trunk decay | • root decay |
| • buried root collar | • shallow root system |
| • girdling roots | • cut, missing, or restricted roots |
| • excessive lean | • asymmetrical crown |
| • cracks | • low live crown ratio |
| • excessive height | • excessive soil moisture |

Provide Clearance

The objective of clearance pruning is to reduce interference with people, activities, infrastructure, buildings, traffic, lines-of-sight, desired views, or health and growth of other plants. Clearance pruning plays an important role in ensuring safe and reliable electrical utility services and, in some cases, compliance with regulatory and other requirements. Typical clearance distances are defined in Table 2.

Directional pruning is the preferred way to direct branch growth, often well in advance of growth within the clearance area. Branches that are causing or will cause interference should be removed or reduced. When reducing these branches, make the cut to a lateral branch that is not growing in the direction of the clearance zone when possible. This directs growth away from the specified clearance area and promotes compatible branch structure (Figure 9). Clearance pruning often must be done on a regular cycle because new growth eventually will fill the void created by pruning.

To slow regrowth after pruning, application of a tree growth regulator can be considered. When growth within the clearance area cannot be reliably prevented by pruning or using tree growth regulators, whole tree relocation or removal may be required.

Maintain Health

The objective of pruning to maintain tree health typically includes the removal of infested, infected, damaged, or rubbing branches. The removal or reduction of diseased or insect-infested branches has been called sanitation pruning. Sanitation pruning may reduce the spread of pests within the tree or to adjacent trees, especially when combined with pest management practices.

Reducing branch density at the crown periphery can allow more wind to pass through the crown and can provide more light penetration that can promote drying to reduce foliar diseases; this type of pruning is considered in the next section.

Reduce Density

Reducing density of foliage at the crown periphery (previously called *thinning*) is sometimes performed to increase wind or light penetration for aesthetic

reasons and to promote interior foliage development. This objective is accomplished by selective removal (young trees) or reduction (mature trees) of the longest and largest branches. The dominant leader is rarely reduced or removed. Vines and some epiphytes may also excessively shade tree foliage and may be included in this objective or as its own objective. The objective of reducing density may be achieved in combination with improving tree structure. When large competing branches are reduced or removed, the effect will be to reduce foliar density. Improving tree structure is an objective that is usually considered more important than reducing density. Moreover, pruning to improve structure often serves to reduce density.

The removal of live interior and lower lateral branches should be avoided. Removal of a majority of lower or interior branches results in a concentration of growth at branch ends (lion-tailing) and is an unacceptable practice.

Restoration

The objective of restoration is to improve a tree or shrub's structure, form, or appearance after it has been topped, severely headed, vandalized, lion-tailed, broken in a storm, or otherwise damaged. This is done through the selective removal and/or reduction of branches, sprouts, and stubs to encourage growth in a more natural form. Crown restoration is usually accomplished over several pruning cycles. Trees that have been restored may require routine risk mitigation pruning to manage loads on sprouts, scaffold branches, and/or stems that have previously failed or been damaged.

On trees with many sprouts originating near the ends of branch stubs, some sprouts are selected to become permanent branches and to reform a more natural-appearing crown. To accomplish this objective, consider shortening some sprouts, removing others, and leaving some untouched. Some vigorous sprouts that will remain as branches may need to be shortened to control growth and ensure adequate attachment for the size of the sprout. To develop one dominant sprout to replace the broken branch requires two or more prunings. Often two or more sprouts are needed to resume the natural growth habit.

Lion-tailed trees can be restored by first allowing sprouts to develop along the interior portion of a branch for one to several years depending on the size, age, health, climate, and condition of the tree. After the rate of sprout growth slows, some of the sprouts are removed and/or reduced along the entire length of the

branch, such that they are evenly distributed and spaced.

Restoration may require a variety of types of cuts. At times, heading cuts may be preferable to branch removal cuts or reduction cuts to preserve as much of a damaged branch as practical. This is sometimes the case in restoration after storm damage.

Size Management

When the objective is to make a tree or shrub smaller while maintaining its natural shape, size management pruning strategies are applied.

Size management may be done for aesthetic reasons, when the tree has overgrown its site, when it obstructs a line-of-sight, to reduce loads (as in risk mitigation pruning), or to remove branches that will interfere with powerlines or other structures. In the past, this has been termed *crown reduction*.

Size management is accomplished with branch removal cuts, reduction cuts, or rarely, heading cuts (Figure 10). The size of cuts should be as small as possible to reduce risk of decay entry. On decay-prone species, cuts less than 4 inches (10 cm) in diameter are preferred.

A particular application of size management is retrenchment. The objective of the retrenchment process is to preserve declining overmature trees by mimicking the natural process sometimes seen in certain species of trees as they age, losing their upper branches/trunk and shedding overextended, decayed, weakly attached, or damaged branches.

With branch loss, energy is redirected into epicormic sprout growth on interior and lower portions of the crown. Retrenchment is sometimes performed to preserve trees of high value or special heritage, while minimizing the likelihood of failure. Arborists should determine whether retrenchment is appropriate, considering factors such as species, size, condition, branch architecture, placement, aesthetics, and expected response.

Shrub Rejuvenation

The objective of shrub rejuvenation is to improve the health and appearance of especially large-growing mature plants that are overly dense or declining

in health due to the size or age of some of the stems.

Rejuvenation, reduction, and even density reduction pruning are often joint strategies for mature shrub pruning.

Rejuvenation is accomplished by removing or reducing large or declining stems to near ground level to allow space and energy for new sprout development. This is done with removal, reduction, or heading cuts on older stems near ground level. Cuts are made as low as possible and depend on vitality, location, and species. Some species are more able to withstand cuts lower on the stem than others, and heavily shaded stubs may not produce sprouts. Excessive new sprouts may need to be removed or reduced to manage their growth the next time the shrub is pruned. Plant growth regulators can reduce excessive sprout growth on some species.

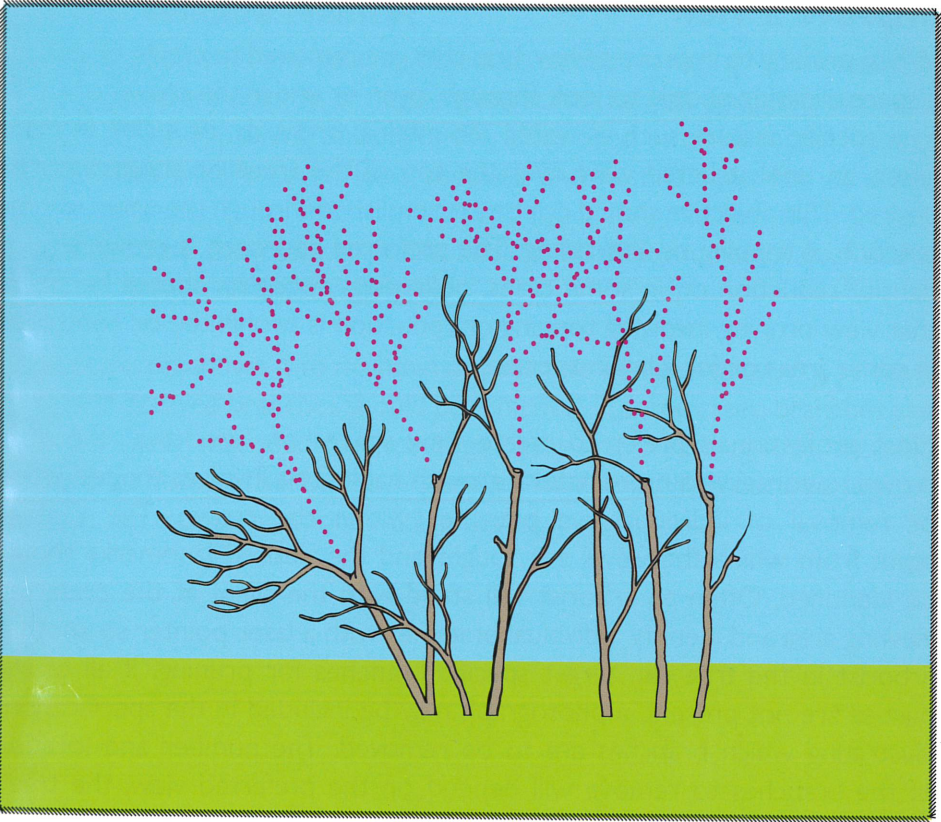


Figure 10. Size management can be achieved with a combination of branch removal and reduction cuts or, rarely, heading cuts. With these shrubs, mainly small-diameter reduction cuts were made.

Flower or Fruit Production

The objective of increasing or decreasing the number or size of fruit or flowers can be addressed, in some cases, with pruning. When fruit density is too great, branch failure or large fruit drop can occur. Reduction cuts or shearing done when flower buds are present will greatly reduce the number of flowers and subsequent fruit. In addition to pruning to manage fruit density, there are chemical treatments available in some areas that can reduce fruit production.

Fruit production can be increased by pruning to create a strong structure with adequate sunlight exposure. Fruit tree pruning for commercial production is not within the scope of this publication, but there are numerous other publications on this topic. The timing of pruning can greatly affect flower production. This topic is covered under “When to Prune.”

Improve a View

When pruning to improve a view, branches are removed to create or enlarge a space allowing people to look through, over, or under the crown of a tree to a specific feature such as water, mountains, orchards, or a city. In many cases, an unobstructed view over the top of the trees or shrubs may be desired. This objective should not be accomplished through the unacceptable practice of topping or lion-tailing. The preferred approach is crown size or density reduction or, in some cases, pollarding. Arborists should be aware that view pruning involving topping or reduction is prohibited or controlled in some areas or for certain species.

Most professionals prefer to create view spaces or “windows” though a crown to conserve a more natural growth habit. This involves the reduction or removal of individual live branches within the crown. The vantage point from which the views are sought and the desired landmarks should be identified. Often an arborist will stand with the client at the preferred viewing area and identify individual branches with a laser pointer so another arborist in the tree can target specific branches for pruning. If all of the parties are not present, a photograph may be included in the specifications illustrating which branches are to be removed. The number and location of the branches to remove will depend on the preferred view, the tree’s tolerance of branch loss, and the client’s tolerance for obstructing branches. Maintaining window-like views generally requires less frequent pruning than

crown reduction. Tree growth regulators are sometimes used in conjunction with view-pruning to extend the pruning interval.

Improve Aesthetics

When the objective is to improve aesthetics, this often involves shaping or balancing the crown of shrubs and, in some cases, trees. Other times some small ornamental trees are pruned to remove some small upward- and downward-growing branches to create a horizontal, layered effect.

Pruning to improve aesthetics typically includes the removal or reduction of undesirable branches such as dead, diseased, broken, crossing, or those growing outside of the desired shape of the crown. Branches to be removed will be highly dependent on the pruning systems employed such as natural, pollarding, topiary, and espalier.

Manage Wildlife Habitat

A consideration with any pruning objective can be managing wildlife habitat. Pruning can have a positive or negative impact on habitat. Tradeoffs between habitat and other pruning objectives therefore need to be balanced. Pruning can decrease wildlife cover, food supplies, and nesting sites. For example, many wildlife species are reliant on fruit and dead, dying, or decayed branches. Removing these can reduce wildlife habitat. In addition, removal of active bird nests is illegal in most countries.

If one of the objectives is to maintain or promote wildlife habitat, not all dead, dying, and decayed branches should be removed. In some cases, branches can be intentionally wounded to encourage decay and create cavities intended for nesting. Some arborists have gone as far as installing decayed logs or boxes in the tree to promote wildlife nesting.

Pruning Cuts

Tree Biology

To predict and appreciate how trees will respond to different types of pruning cuts, it is necessary to understand some tree biology. Pruning live branches reduces a tree's ability to photosynthesize and manufacture sugar, at least for a short period. Pruning live branches converts live wood behind the pruning cut to nonliving wood. Pruning also creates wounds that the tree must expend energy to close and defend. Routine live-branch removal does not necessarily improve tree health, and some practices, such as topping, can have adverse effects on both tree health and structure. In addition, excessive branch removal from the interior of the crown (lion-tailing) can actually increase the likelihood of branch failure. These are the costs of removing live branches. The costs and benefits of pruning, such as improved branch architecture and reduced failure potential, should be assessed when developing pruning objectives and deciding on pruning amounts.

Compartmentalization or CODIT (compartmentalization of decay in trees) is a model that illustrates the defense processes that limit the spread of damage/decay based on physical and chemical properties of the wood. Compartmentalization relies on both pre-existing defense strategies and active responses in living cells. If large cuts are made exposing heartwood there will be no active response, leaving only pre-existing defense mechanisms to slow or stop decay movement. In decay-prone tree and shrub species, the more wood exposed the greater the potential for decay. Smaller wounds will typically be closed more readily, resulting in less decay over time. Wound closure occurs when woundwood around the edges of the cut covers the wound.

When branches remain small relative to the trunk diameter, a swollen collar often develops around the base of the branch. The collar is formed by overlapping and intermingled branch and trunk wood (Figure 11). The overlapping and intermingled wood makes a strong union. Inside the collar on most trees is a chemical barrier called the branch protection zone. Its function is to retard the spread of air and decay organisms into the trunk. If the collar is removed or severely damaged, decay can more readily spread into the wood of the stem or parent branch behind the pruning cut.

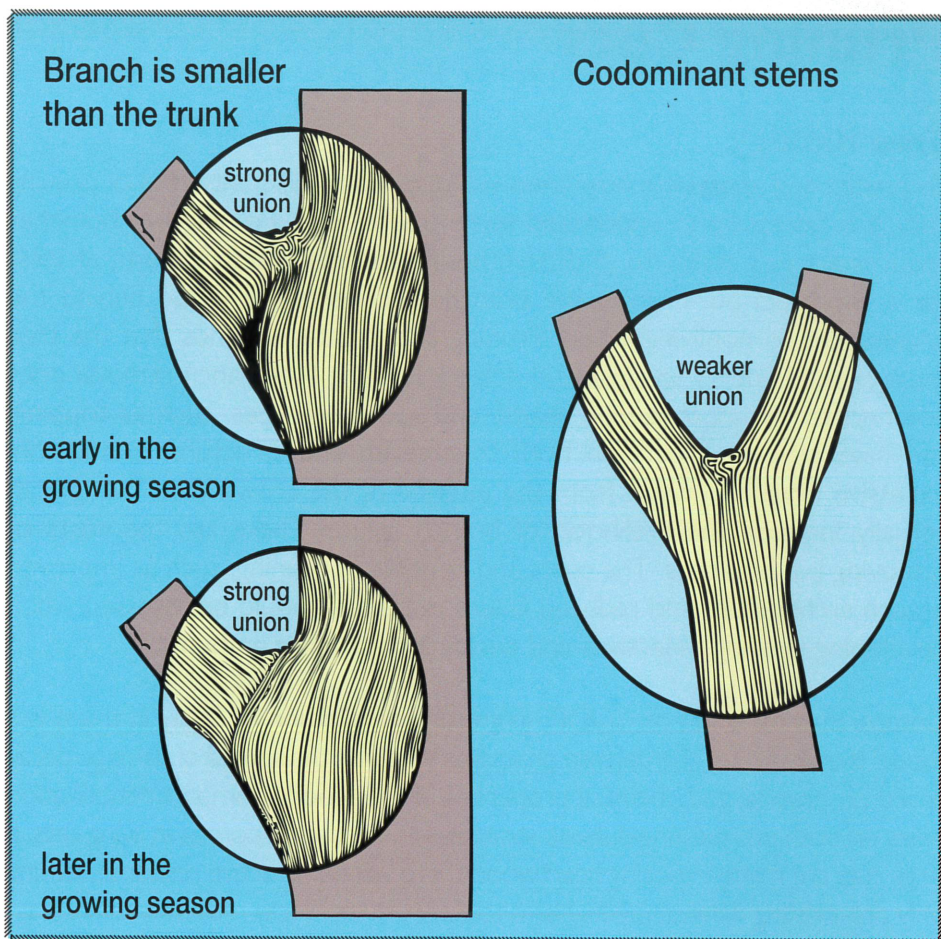


Figure 11. Small branches are well connected to the trunk as a result of overlapping and intermingled trunk and branch tissue in the union (left). Codominant stems are not as well connected because wood tissue does not overlap in the union (right).

A branch bark ridge (Figure 12) is the area of bark at the top of a branch union where the growth and expansion of the trunk or parent stem and adjoining branch push the bark into a ridge. The branch bark ridge should not be damaged during pruning.

When two or more stems of approximately equal size (codominant stems, with diameter ratios greater than 80 percent) arise from a union, there is little overlapping or intermingled wood, at least on young stems. The result is a weaker union. Decay can enter when one stem is removed because there is no branch protection zone at the base of a codominant stem (Figure 11).

The union is structurally even weaker when bark is included in the attachment. Included bark is bark that is imbedded inside the union as the closely spaced stems increase in size. This condition further weakens the union, making the tree prone to failure at that point. A normal branch bark ridge is not formed at the top of the union when included bark is present.

Pruning is a growth-retarding process that removes stored energy and growing points from the pruned portion of a plant. Energy in the form of starch, sugars, and oils is stored in branches, stems, trunk, and roots. This energy can be conserved by removing the fewest number of living branches necessary to accomplish the objective. Excessive branch removal depletes these reserves and reduces the ability of the tree to produce more energy through photosynthesis.

In deciduous species (angiosperms), pruning is a bud-triggering process. Latent buds are stimulated by an increase in sunlight and the removal of buds that produce growth-regulating hormones. Many trees generate sprouts in response to excessive pruning. Sprouting generates new growth to replace foliage to photosynthesize and replace the energy. Many conifers (gymnosperms) will not produce sprouts following pruning.

Although pruning live branches has a cost, it is essential to forming good structure, maintaining clearances, mitigating risk, and to meeting other objectives, so it is a necessary part of a tree care program.

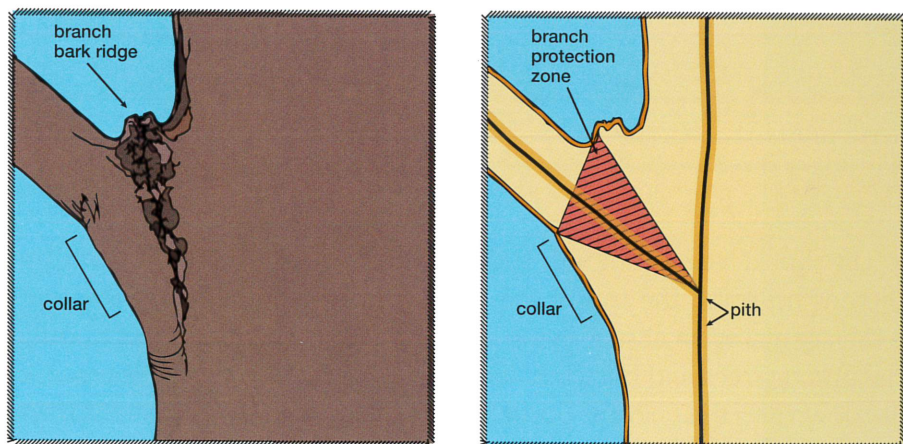


Figure 12. A branch protection zone at the base of branches reduces the spread of decay into the stem.

Types of Pruning Cuts

There are four types of pruning cuts in arboriculture: branch removal cut, reduction cut, heading cut, and shearing cut.

Branch Removal Cut

A branch removal cut (previously termed a *thinning cut* or *removal cut*) removes the smaller of two branches at a union with the parent stem (Figure 13). Removal cuts retain the branch bark ridge and branch collar (when present) and do not create a stub. Branch removal cuts are more likely than reduction and heading cuts to allow a tree's branch protection zone and compartmentalization strategies to work. In this publication and when writing specifications, branch removal cuts are referred to as *branch removal* or simply *remove*.

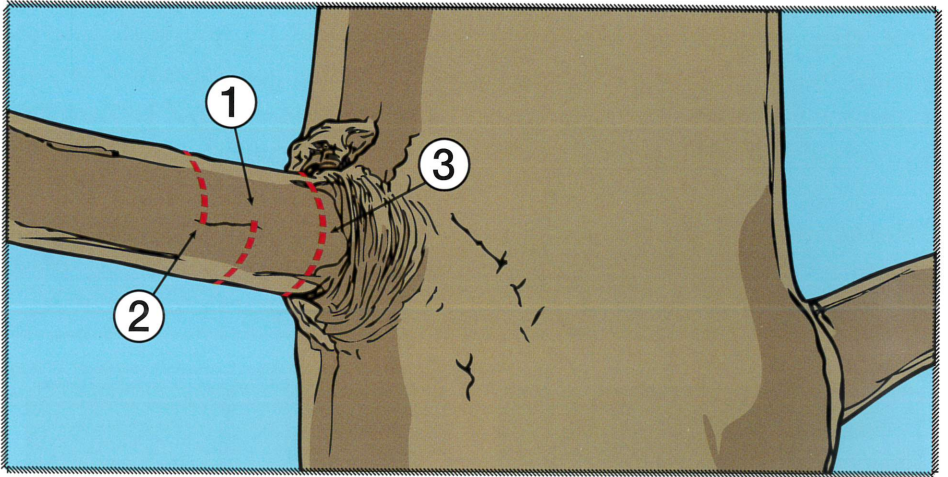


Figure 13. A branch removal cut removes the branch at the parent stem without cutting into the branch bark ridge, branch collar, or leaving a stub. Here the 3-cut method is illustrated. This method reduces the likelihood of tearing the stem bark when the cut is made.

The cut should leave a smooth surface with no jagged edges or torn bark. If there is no collar, the top of the cut should be located where the top of the branch makes an abrupt upward turn at the union. The correct position varies among trees and branches. If there is a bark inclusion in the union, cut as far down into the union as possible without injuring trunk or parent branch wood. Making cuts flush to the parent stem or branch is not an acceptable practice.

Reduction Cut

A reduction cut (previously called *cutting to a lateral*) removes the larger of two or more branches, stems, or codominant stems to a live lateral branch or stem, typically at least one-third the diameter of the stem being removed (Figure 14). Cutting back to a lateral that is smaller in size is considered a heading cut. Reduction cuts are commonly used in structural pruning, subordination, directional pruning, density reduction, risk mitigation, or when reducing plant size. Reduction cuts are referred to in specifications as *branch reduction*, *reduction*, or *reduce*.

Reduction cuts are typically made at an angle relative to the remaining stem. When possible, avoid large (greater than 4 inches [10 cm] diameter) reduction cuts and cuts that expose heartwood on species that are poor compartmentalizers. Cut size is less important on temporary branches that will be removed later.

Trees do not always compartmentalize reduction cut wounds as well as wounds from branch removal cuts. The ability of the tree to compartmentalize wounds is a function of the size of the cut, the age of the cut stem or branch, tree vitality, species, and the time of year. The smaller the cut and the more vigorous the tree, the better the wound closure and compartmentalization.

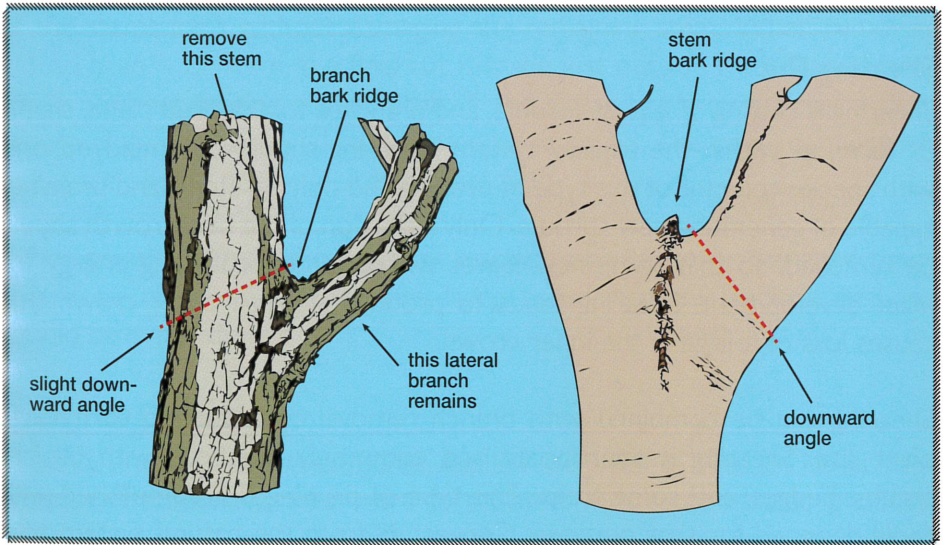


Figure 14. A reduction cut removes the larger of two or more branches, stems, or codominant stems to a branch or stem that is typically at least one-third the diameter of the stem being removed.

Heading Cut

A heading cut removes a branch or stem between nodes, to a bud, or to a live branch less than one-third the diameter of the branch or stem being removed. Except when cutting back to a small lateral branch, this type of cut leaves a stub. Heading cuts are rarely appropriate on established trees.

Heading cuts can, however, be used:

- on current season's growth, especially when shearing within the topiary system,
- to remove old flower heads,
- to remove developing fruit,
- to reduce the length of a young sprout,
- to start a pollard,
- to rejuvenate or manage the size of a shrub,
- to create or preserve wildlife habitat,
- for structural development on young plants, and
- to avoid the removal of a large branch where the alternative is making a large cut on the trunk or scaffold branch.

A heading cut should only be made if the remaining lateral(s) or shoots that grow from retained buds are expected to sustain the remaining branch. Heading should not be used to reduce the height or size of trees in other instances. This practice is called *topping* and can be damaging.

Shearing Cut

Shearing is cutting of leaves, sprouts, and branches to a desired plane, shape, or form, as within the topiary system. Shearing should be employed only with species tolerant of this type of pruning and only on stems and branches capable of generating new sprouts. Only a portion of the new growth should be removed, so that some new leaves will continue producing energy for plant development. Shearing tends to produce a dense outer crown that causes loss of foliage in the inner crown.

Shearing can be combined with branch removal or reduction to manage plant size. Shearing is appropriate and commonly practiced with topiary shrubs, hedges, and some trees. This type of pruning is accomplished with tools designed for that purpose. Converting from the natural system to a topiary system by "rounding over" large trees is usually not appropriate.

Making Pruning Cuts

Because a tree's ability to close pruning wounds and compartmentalize decay is crucial to the long-term health and stability of a tree, the smallest diameter cuts that meet the objective are preferred. The number and size of cuts that expose heartwood should be minimized.

Large or heavy branches should be precut using three cuts to avoid splitting the wood or tearing the bark (Figure 13). The first cut undercuts a large branch 1 to 2 feet (0.3 to 0.6 m) out from the parent branch or trunk. The undercut reduces the chance of the branch tearing bark as it is removed. The second cut is made from the top directly above the undercut or farther out on the branch. The third and final cut is to remove the stub without tearing bark below the cut and should leave adjacent bark firmly attached.

With large trees, branches often need to be lowered rather than dropped to the ground to reduce damage to the tree and objects below the tree. This procedure is done with ropes, cranes, or other equipment. Details on these procedures can be found in *The Art and Science of Practical Rigging*.

When removing a branch with a narrow angle of attachment, the cut should be made from the outside (underside) of the branch to prevent damage to the remaining branch or stem. When removing a branch with included bark, the cut should be made as close as possible to the point where the wood of the stems joins without damaging the remaining stem. When removing a dead branch or stem, the final cut is made just outside the collar of living tissue, without leaving a dead stub. If the collar has grown along a dead branch stub, only the dead stub should be removed. The collar contains live tissue and should not be injured or removed.

When treating damaged bark (bark tracing), only loose or damaged tissue should be removed. Cutting into living tissue increases wound size and should be avoided.

Wound Dressing

Wound dressings are treatments applied to pruning cuts or other tree wounds. Traditionally, they were formulated with asphalt-based products in paint or spray form. Asphalt wound dressings were once thought to accelerate wound closure and reduce decay. Research shows asphalt

products do not reduce the spread of decay. However, studies have shown the beneficial effects of wound dressings in reducing insect attraction. This is the case for the oak wilt vector and some boring insects at certain times of the year. Chemical wound treatment can also suppress sprout production and mistletoe.

Wound dressings are occasionally used for cosmetic purposes. If a dressing must be applied, use only a light coating of a nonphytotoxic material. Examples include many spray paints or brushed-on latex paint. Wound dressings and especially sealants should not be applied to decayed wood due to their potential for keeping the area moist and promoting decay.

Pruning Practices

How Much to Prune

The amount of material to be removed should be governed by client objectives, condition of the tree, the pruning cycle, and the tree's ability to tolerate pruning. The pruning amount should be included in the scope of work, proposal, or work order. It can be a specified number of pruning cuts of certain sizes and types. For example, "remove the 6-inch (15-cm) diameter¹ branch over the house," or "reduce three 4-inch (10-cm) diameter branches growing toward the street by making 2- to 2.5-inch (5-6 cm) cuts."

The amount of foliage to be removed is sometimes expressed as the percentage of foliage or buds to be removed. The goal is to avoid removing more live branches than necessary to achieve the objective. Some guidelines suggest not removing more than 25 percent within a growing season. This guideline may be helpful as a starting point for thought, but it is too broad to apply to all trees. Vigorous, young trees usually tolerate more branch removal. Conversely, mature, stressed, or sensitive trees may tolerate only minimal removal of live branches. Excessive removal could stress some trees, causing decline, reduced defense against pests, or sunburned bark tissue. In some cases, such as for clearance or risk reduction, a large amount of foliage may need to be removed from a section of the crown to meet the objective.

For managing height and spread of the crown or managing length of individual branches, the amount to remove may be expressed as the length of the branch section to be removed and/or with the size and type of pruning cut to make. When pruning for clearance, quantity may be expressed as removal of enough branches or branch length to provide a specified clearance distance.

Cut sizes can be included to guide the working arborist as to which branches to remove or reduce.

For dead, dying, cracked, and broken branches, quantity is often not specified, but it is implied to be all that can be found. A minimum and sometimes a maximum diameter should be specified (e.g., remove all dead branches 2 inches [5 cm] in diameter or larger). This may be from the entire crown or

1. Branch diameter is estimated at the point of attachment to the parent branch or stem.

from a more limited area within the crown such as above a “target” or up to a specified height.

When to Prune

Removal of dead, dying, diseased, or broken branches can be accomplished any time with little negative effect on the tree. Trees with Dutch elm disease (*Ophiostoma* spp.) or other vascular and canker diseases should have symptomatic branches removed as soon as they are identified to limit the spread of the pathogen. Healthy, live branches can also be pruned in any season, but there are some short-term differences in tree response.

Wound closure is generally fastest if pruning is done in the spring and early summer. Spring growth can be maximized and defects are easier to see on deciduous trees if they are pruned in the winter or before growth resumes in early spring. Pruning certain species when dormant can minimize the likelihood of insect pest problems associated with wounding.

In early spring, when there is root pressure pushing sap flow in certain deciduous species, such as maples (*Acer*), birches (*Betula*), and hornbeam (*Carpinus*), there can be significant sap flow from pruning wounds (Table 5). Although unattractive, sap drainage has little negative effect on tree growth or health. Sap dripping can be avoided by pruning in summer or fall.

The timing of pruning can be an important part of a Plant Health Care program. For example, one way to reduce the spread of oak wilt and Dutch elm disease is to prune when the vector insect is not active. This can be region dependent; for example, where oak wilt is present in Texas, pruning susceptible trees is best performed in the summer months. In the Northern United States, oaks are

Table 5. Trees that often drip sap (bleed) during late winter, early spring.

- | | |
|--|-----------------------------------|
| • Avocado (<i>Persea americana</i>) | • Birch (<i>Betula</i> spp.) |
| • Cottonwood (<i>Populus</i> spp.) | • Elm (<i>Ulmus</i> spp.) |
| • Flowering dogwood (<i>Cornus florida</i>) | • Hackberry (<i>Celtis</i> spp.) |
| • Honeylocust (<i>Gleditsia triacanthos</i>) | • Hornbeam (<i>Carpinus</i>) |
| • Magnolia (<i>Magnolia</i> spp.) | • Maple (<i>Acer</i> spp.) |
| • Mesquite (<i>Prosopis</i> spp.) | • Poplar (<i>Populus</i> spp.) |
| • Silk-oak (<i>Grevillea robusta</i>) | • Walnut (<i>Juglans</i> spp.) |
| • Willow (<i>Salix</i> spp.) | |

pruned in the winter to reduce the likelihood of infection. Arborists should comply with any local or regional regulations.

Plant growth rate can be reduced if live-branch pruning takes place during or soon after the initial growth flush. This is the period when trees have just expended a great deal of stored energy to produce roots, foliage, and early shoot growth. In some cases, slowing of growth is a goal; however, pruning live branches from stressed trees at this time can reduce their energy reserves even further, leading to decline or death.

Flowering can be prevented or enhanced by pruning at a certain time of year. To retain the most flowers on plants that bloom on current season's growth (new wood), such as crapemyrtle (*Lagerstroemia*) or linden (*Tilia*), prune in winter or in the summer just after bloom. Plants that bloom on the previous season's growth (old wood), such as crabapples (*Malus*), cherries (*Prunus*), and hydrangeas (*Hydrangea*), prune just after bloom to preserve the flower display.

Fruit trees can be pruned after bloom to thin fruit or during the dormant season to enhance structure and distribute fruiting wood.

Work Practices

Equipment and work practices that damage living tissue and bark beyond the scope of the work should be avoided. At times it may be necessary to use rigging equipment to lower branches to protect structures, property, or other parts of the tree.

Cut or detached branches should always be removed from the crown upon completion of pruning, whenever trees are left unattended, or at the end of the workday, unless otherwise specified in the scope of work.

When pruning has a high potential to spread pests, appropriate precautions should be taken. Precautions may include avoiding pruning during certain times of year, sterilizing tools, or applying pest management measures. If pruning exposes thin bark and has a high potential to result in sunscald, consider using a temporary protective covering for vulnerable areas or pruning fewer branches so as to minimize bark exposure to direct sun.

When frequent or excessive pruning is required to achieve objectives,

alternatives should be considered. Alternatives may include relocation of the plant, treatment with growth regulators, or removal and replacement with an appropriate plant. With tree removal, the increased exposure of adjacent trees may affect their likelihood of failure.

Tools and Equipment

Select pruning tools appropriate for the size of cuts being made. Scissor-type pruning tools (Figure 15) such as pruning shears (secateurs) and lopping shears (loppers) are preferred for smaller branches, typically less than 1-inch (2.5 cm) in diameter.

Dull, anvil-type pruning tools, with a blade that cuts to a flat surface, should be avoided because they crush tissue. To avoid leaving a small stub, place the blade side of the pruner against the stem. For larger cuts, handsaws or chainsaws are preferred. Pruners, handsaws, and chainsaws should be sharp and maintained according to manufacturer's recommendations so as to make clean cuts with a smooth surface without jagged edges or tears.

In the majority of cases, climbing spurs should not to be used for pruning operations. The exceptions are: when branches are more than a throwline distance apart and there are no other means of climbing the tree, or when the bark is thick enough to prevent damage to the cork cambium (for example, on thick-barked species such as mature redwoods). It is acceptable to use climbing spurs to reach an injured coworker.

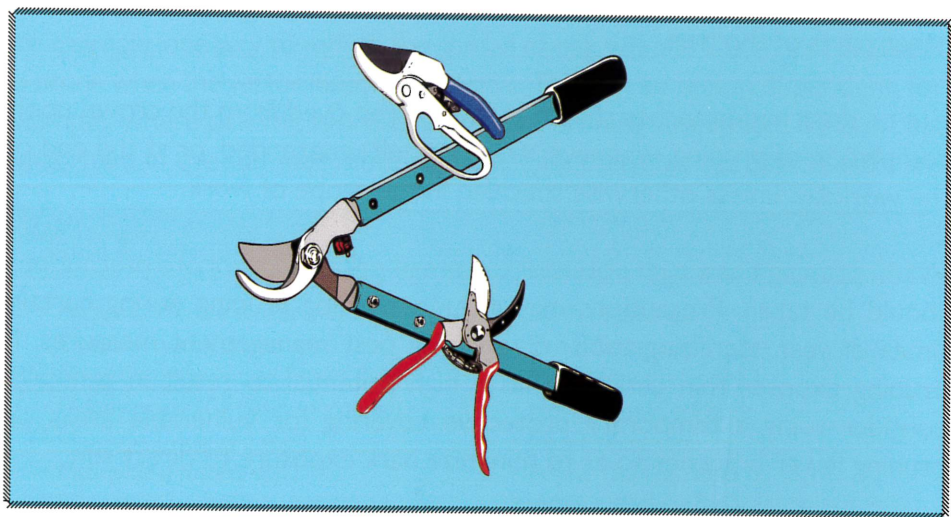


Figure 15. Scissor-type pruning tools such as pruning shears (secateurs) and lopping shears (loppers) are preferred when making smaller cuts

Although a rare occurrence, the likelihood of spreading pathogens on pruning tools varies with the disease, plant species, tools, environmental conditions, and timing. Chainsaws are difficult, if not impossible, to sterilize during pruning operations. If tools are sterilized, it is important to use a material that will not injure plant tissues or damage the equipment. Materials commonly used to sterilize tools include bleach (10 percent solution) or Lysol™ (Figure 16). Handsaw blades can be sterilized by heating the blade with a propane torch, stopping well before the blade turns red. For specific disease–host plant recommendations, check the local land grant university website, or consult with an extension agent to determine whether such procedures are necessary.

Mechanical Pruning

Mechanical pruning is performed with heavy equipment that is fitted with power saws or other cutting devices (e.g., saws mounted on tractor booms or suspended from a helicopter). Mechanical pruning is often used in orchards, on long sections of right-of-way, and along highways to provide clearance and reduce labor costs. Because mechanical tree pruning is not as selective as manual methods, it should be restricted to remote/rural locations, away from settled areas and dwellings, or during emergency situations. Mechanical pruning cuts made to provide clearance should be made close to the main stem, outside of the branch bark ridge and branch collar. Precautions should be taken to avoid trunk wounding.

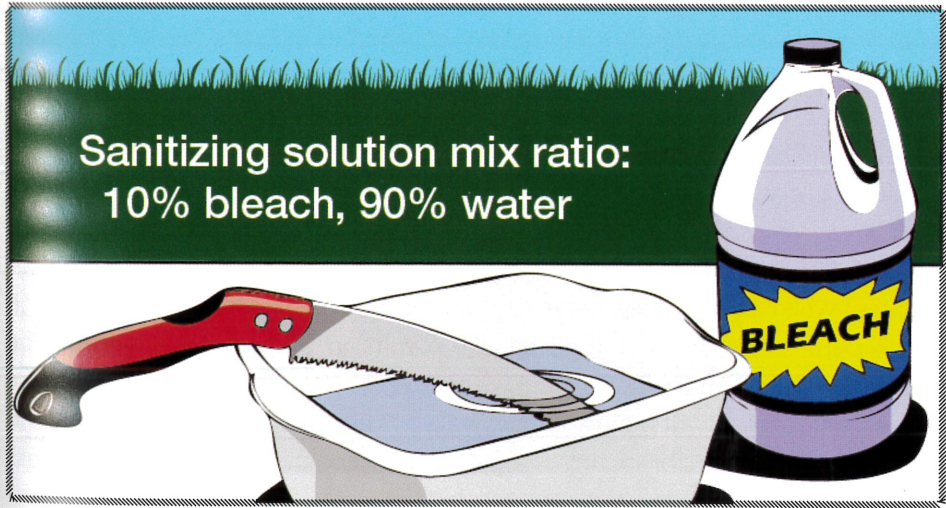


Figure 16. It is difficult and usually unnecessary to sterilize pruning tools. When it needs to be done, dipping into a bleach or Lysol™ solution can be effective treatments

Poor Pruning Practices

Various pruning practices can be harmful to plants, for example: making flush cuts; unnecessarily leaving a stub; removing an excessive number of live branches; or pruning at a time or in a manner that spreads disease.

Some specific pruning practices known to be damaging to trees are topping, lion-tailing, and excessive thinning, raising, or reduction. Topping is the reduction of tree size done by cutting to stubs without regard for long-term tree health or structural integrity. Lion-tailing is the removal of lower and interior branches on main scaffolds that results in a concentration of growth at branch ends. Both of these practices are considered unacceptable. Excessive thinning can result in similar problems to lion-tailing along with excessive wounding, sunscald, and temporarily increasing loads. Removal of too much of the lower crown moves the center of force farther up and out and reduces a tree's ability to dissipate energy through branch movement. This can result in greater forces on the crown and more branch or whole-tree failures.

Conifers

Conifers benefit from the removal of dead, dying, and diseased branches, as do other trees. They can also benefit from structural pruning after the dominant leader is damaged. At times, they may need clearance pruning. However, some pruning strategies are not appropriate for conifers. For example, pruning for branch spacing and scaffold branch development is usually not necessary. Reducing density on spruces and firs rarely is needed, although in windy areas branch and/or crown reduction can reduce wind resistance and, therefore, whole-tree failures. Removing entire branches to the stem as a means to reduce wind resistance may increase the likelihood of failure of the remaining branches and is seldom recommended on conifers with low live crown ratios. Pine growth may be managed by shortening new growth (candles) rather than branch removal. Few conifer tree species respond well to pollarding; some tolerate reduction. Reducing branch length beyond the zone of live foliage usually results in branch death, unless the species (such as Canary Island pine) is capable of sprouting. Few fir and spruce (*Picea*) produce sprouts; pine species vary widely in sprout production; and new growth on old branches is common in coast redwood and cypress (*Cupressus*).

Palms

Palms do not require pruning to remain healthy; they do not require pruning to prevent storm damage; in fact, there is evidence they may be damaged more when a storm follows recent pruning to remove older (lower) fronds. Palm pruning is the removal of fronds, flowers, fruit, stems, or loose petioles that may pose a danger to structures, climbers, electrical facilities, and people nearby. Palms also may be pruned for aesthetic reasons to eliminate basal sprouts, dead fronds, and seedpods. Live, healthy fronds should not be removed except when necessary to provide clearance. If live, healthy fronds must be removed, avoid removing those that initiate above horizontal. Since palms extract nutrients from declining fronds, nutrient deficient plants should be fertilized before declining fronds are removed to reduce the impact of nutrient loss than may accelerate the decline (Figure 17).

Fronds to be removed should be cut close to the petiole base without damaging living trunk tissue. Removing dead petiole bases by cutting into live tissue (a procedure called shaving, skinning, peeling, or sanding) is not an acceptable practice because it often allows the entry of disease that will shorten plant life expectancy. When pruning large specimens such as date palms (*Phoenix*), the three-cut pruning technique should be used to avoid heavy fronds ripping down the trunk.

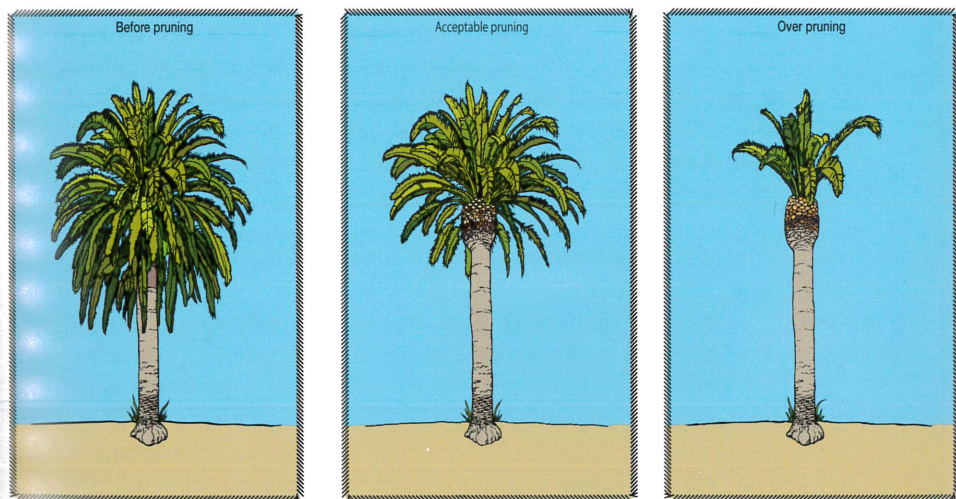


Figure 17. Palm pruning primarily removes dead or dying fronds. When live fronds are removed, it should only be those that are below horizontal.

When pruning palms infected by or susceptible to *Fusarium* wilt, the use of chainsaws should be avoided. Handsaws should be sterilized or a new blade should be used between trees to avoid spreading the disease.

Climbing spikes should not be used to ascend palms for pruning. Only climbing lines, ladders, pole tools, or aerial lift equipment should be employed to maintain palms. To ensure worker safety, removal of palm frond skirts should be performed from the top down (ANSI Z133).

Bamboo

Pruning bamboo is generally not necessary, but it can improve the aesthetics of a stand. Culms and branches should be pruned by making cuts just above nodes, without leaving a stub. The plant will not grow back from the point of the cut, but branch development below the cut will be enhanced on certain species. Bamboo is best pruned in late summer or fall after sprouts have been formed. If pruning is done while sprouts are being produced, energy reserves can be reduced.



Pruning Specifications

Written specifications are key to good pruning because they communicate what is to be done. Specifications protect both the client and the arborist by ensuring that everyone clearly understands the objectives and scope of the work. Municipalities, utilities, commercial arborists, and property owners all benefit from using specifications. Commercial tree care companies should apply their national standards when writing pruning specifications. The United States, Germany, England, and other countries have national standards for tree pruning.

Specifications should include the pruning systems, objectives, pruning cut type(s), size range of branches to remove, amount to remove, and location of branches (Table 6). Amount can be expressed as a percentage, size, length, or number of branches to be removed. Specifications should also include the time frame for completion, the plan for disposal or repurposing of debris, and a recommendation for re-inspection or re-pruning (pruning interval).

The following are examples of pruning specifications. The specifications you develop should be based on client objectives and on the species, condition, and size of the trees to be pruned.

Table 6. Information that should be included in written pruning specifications.

- Plant name (common or genus and species)
- Location (address and place in the landscape)
- Pruning system to be applied (e.g., natural, pollard, topiary [hedge, shape])
- Pruning objective (e.g., manage risk, improve structure, clearance, manage size)
- Type of parts to remove (e.g., live or dead branches, fruit, mistletoe)
- Size range of branches to remove (e.g., diameter range, maximum or minimum diameter, length)
- Location within the crown of the parts (e.g., whole crown, near house, over street)
- Amount to remove (e.g., all [as with dead branches over 2 inches {5 cm} in diameter], number of branches, or a percentage of foliage [as with ~ten percent of live branches])
- Plan for disposal of debris (e.g., remove all debris, chip brush, and leave wood chips, leave firewood)
- Time frame for completion of the work (e.g., 2 weeks, over the winter, July)
- Re-inspection or pruning interval (e.g., 5 years, annual, monthly during the growing season)
- Additional information as needed (e.g., topiary shape, clearance distances, desired view)

Specification Examples

EXAMPLE ONE:

Specification for pruning young street trees

Trees to prune: Twenty-seven oak (*Quercus*) street trees that are 4- to 8-inch (10- to 20-cm) diameter at breast height (dbh) and 20 to 30 feet (6 to 9 m) tall along Sweetwater Lane from the 1600 block to the 1800 block.

Personnel qualifications: All work shall be performed under the supervision of an ISA Certified Arborist®, an ISA Board Certified Master Arborist®, or equivalent.

Pruning system: Natural.

Objective: To improve crown structure and provide clearance for adjacent sidewalk and street.

Branches to prune:

1. Reduce length by two-thirds of any codominant stems or upright branches that compete with the dominant leader; if there is no dominant leader, create one by reducing or removing all upright stems except one that is located in the dominant part of the crown.
2. For trees greater than 25 feet (7.6 m) tall, remove all branches that originate from the lower 8 feet (2.4 m) of trunk.
3. Reduce by two-thirds or remove branches at the trunk that are lower than 8 feet (2.4 m) over the sidewalk.
4. Reduce by two-thirds or remove branches at the trunk that are lower than 14 feet (4.3 m) over the street.
5. Remove dead, dying, diseased, and broken branches greater than half an inch (1 cm) in diameter at the point of attachment.
6. Remove sprouts originating on the trunk below 8 feet (2.4 m) including from the root collar.

Limitations:

1. No tree shall be climbed using climbing spurs.

2. All cuts shall be made in accordance with the ANSI A300 pruning standard section 7.
3. No heading or shearing cuts shall be made without authorization.
4. No more than one-third of the foliage shall be removed from an individual tree without authorization.
5. All severed branches shall be removed by the end of the workday.
6. Work practices shall be consistent with the current ANSI A300 Part 1 pruning standard section 8 and the ANSI Z133 Standard.

Debris disposal: All debris will be removed from the work area and recycled as mulch or disposed of at the City green waste recycling center.

Completion date: March 15.

EXAMPLE TWO:

Mature street tree pruning

Trees to prune: All street trees greater than 8-inch (20 cm) dbh on Longpond Drive.

Personnel qualifications: All work shall be performed under the supervision of an ISA Certified Arborist®, an ISA Board Certified Master Arborist®, or equivalent.

Pruning system: Natural.

Objective: Reduce the likelihood of live and dead branch failure.

Branches to remove:

Remove dead, dying, diseased and broken branches 2 inches (5 cm) or larger in diameter at the point of attachment. No branch removal cuts shall be used on any other live branches.

Branches to reduce in length by one-third to one-half:

1. Codominant stems that compete with the dominant leader. Stems that compete with the leader are those with a diameter more than half the trunk diameter measured just beyond the union.
2. Overextended branches that are unusually long or are outside of the shape of the main crown.
3. Branch reduction shall be accomplished using reduction cuts 3 to 4 inches (8 to 10 cm) in diameter, not branch removal cuts. An average of 15 (range of 10 to 20) cuts shall be applied to each tree.

Limitations:

1. No tree shall be climbed using climbing spurs.
2. All cuts shall be made in accordance with the ANSI A300 Part 1 pruning standard section 7.
3. No heading or shearing cuts shall be made without authorization.
4. No more than one-fourth of the foliage shall be removed from an individual tree without authorization.
5. All severed branches shall be removed by the end of the workday.

6. Work practices shall be consistent with the current ANSI A300 Part 1 pruning standard section 8 and the ANSI Z133 standard.

Debris disposal: All debris will be removed from the work area and recycled as mulch or disposed of at the City green waste recycling center.

Completion date: March 15.

EXAMPLE THREE:

Proposal for residential tree work – single tree

Tree to prune: Large valley oak (*Quercus lobata*) in the front yard.

Personnel qualifications: All work will be performed under the supervision of an ISA Certified Arborist®, an ISA Board Certified Master Arborist®, or equivalent.

Pruning system: Natural.

Objective: Reduce the risk of live and dead branch failure.

Branches to prune:

1. Remove dead, dying, diseased, and broken branches greater than 1 inch (25 mm) in diameter at the point of attachment.
2. Reduce the ~8-inch (200 mm) diameter branch on the north side with crack and dead twigs using a 3-inch (75 mm) reduction cut.
3. Reduce the five largest upright-growing branches using two 2.5- to 3-inch (60 to 175 mm) diameter reduction cuts on each branch.

Debris disposal: All debris will be removed from the work area.

Completion date: Spring of this year.

Re-inspection: 5 years.

EXAMPLE FOUR:

Proposal for residential tree work – multiple trees

Trees to prune:	Diameter	Location
London planetree (<i>Platanus x acerifolia</i>)	18-inch (460 mm)	rear of house
Linden/Lime (<i>Tilia spp.</i>)	18- to 24-inch (460 to 610 mm)	right rear of yard
Horsechestnut (<i>Aesculus hippocastanum</i>)	16- to 18-inch (400 to 460 mm)	rear yard

Personnel qualifications: All work shall be performed under the supervision of an ISA Certified Arborist®, an ISA Board Certified Master Arborist®, or state-licensed arborist.

Pruning system: Natural.

Objectives:

1. Reduce likelihood of failure in wind events.
2. Sanitation to reduce risk of boring insect infestations.
3. Provide 6 to 8 feet (1.8 to 2.4 m) of clearance from house.

Branches to prune:

1. Remove dead branches, greater than 2 inches (50 mm) in diameter, extending over yard on all listed trees.
2. On the *Tilia*, reduce one 10-inch (250 mm) diameter live branch over house by 10 to 12 feet (3 to 3.7 m) using three reduction cuts with 3- to 3.5-inch (75 to 90 mm) diameter reduction cuts.
3. Remove or reduce length by one-half all branches greater than 1-inch (25.4 mm) in diameter that have evidence of a borer infestation.

Limitations:

1. No tree shall be climbed using climbing spurs.
2. All cuts shall be made in accordance with the ANSI A300 Pruning standard, section 7.

3. No heading or shearing cuts shall be made.
4. No more than one-third of the foliage or buds shall be removed from an individual tree.
5. All severed branches shall be removed by the end of the workday.
6. Work practices shall be consistent with the current ANSI A300 Part 1 Pruning standard, section 8, and with the ANSI Z133 standard.

Debris removal: All debris will be removed from the work area.

Completion date: Fall of this year.

Re-inspection: 3 years.

EXAMPLE FIVE:

Proposal for residential work – shrubs and hedge

Shrubs to prune: Five Chinese privet (*Ligustrum sinense*) in the front yard and Boxwood (*Buxus*) hedge on right side.

Pruning system: Topiary.

Objective: Maintain current shape, reduce in size.

Shear:

1. New growth that is outside the desired shape of the crown.
2. Do not cut to expose interior branches that do not have live leaves.

Branches to remove:

1. Dead, dying, diseased, and broken branches.
2. Larger stubs.

Debris disposal: Remove all debris.

Completion date: Spring of this year.

Re-inspection: 3 months.

EXAMPLE SIX:

Proposal for residential tree work

Trees to prune:

Two coast redwoods (*Sequoia sempervirens*) in the northeast corner of the property.

Pruning system: Natural.

Objective: Provide clearance for construction of the proposed building.

Branches to prune:

1. Reduce branches on the north side of the tree by 8 to 10 feet (2.4 to 3 m).
2. Reduce lower branches on the west side by 8 to 10 feet (2.4 to 3 m) to a height of 35 feet (10.7 m).

Limitations:

1. No branch removal cuts shall be used at the main stem.
2. No reduction cuts shall be made greater than 4 inches (100 mm) in diameter without approval from the project arborist.
3. Do not reduce tree height.

Debris disposal: The brush is to be chipped and left onsite under the trees for mulch.

Completion date: Within the next two weeks to comply with the nesting bird study recommendations.

The following Pruning Specification Worksheet is also available at www.isa-arbor.com.

Appendix

International Society of Arboriculture - Best Management Practices

Pruning Prescription

Client _____ Date _____

Client Contact _____

Arborist _____ Tree Location _____

Number of trees _____ Species _____ DBH _____ - _____ Tag no. _____ - _____

Pruning Objectives _____

_____ Trees marked with _____

Pruning System ☐ Natural ☐ Pollard ☐ Topiary ☐ Hedge ☐ Espalier ☐ Bonsai ☐ Pleach ☐ Fruit Details _____

Remove:

☐ **Dead branches** with cut types: ☐ Branch removal ☐ Reduction ☐ Heading Cut size: ☐ Min _____ to _____ Max

☐ Whole crown ☐ Outer ☐ Center ☐ Lower ☐ Upper ☐ Over/direction _____

Amount: ☐ All ☐ Number ~ _____ - _____ ☐ _____ % ☐ Specific _____

☐ **Live branches** with cut types: ☐ Branch removal ☐ Reduction ☐ Heading ☐ Shearing _____

Cut size: Min _____ to _____ Max;; or Length of branches kept _____ Details _____

Location: ☐ Whole crown ☐ Lower ☐ Upper ☐ Outer ☐ Center ☐ Largest ☐ Co-dom ☐ Over/direction _____

☐ Clearance distance _____ from _____ ☐ View _____ Details _____

Amount: ☐ Number of branches ~ _____ - _____ ☐ _____ % ☐ Details _____

☐ **Other parts:** _____ ☐ All ☐ Number _____ ☐ _____ % ☐ Details _____

☐ **Remove sprouts/branches** from lower trunk/root collar: Max height _____ ☐ All ☐ Toward _____

Specifics _____

Debris: ☐ Remove all ☐ Leave all ☐ Remove brush ☐ Leave wood chips ☐ Leave wood _____ ☐ _____ dia. cut to _____ length

Completion: Date/season _____ ☐ Call ☐ Text ☐ Email before coming _____

Re-inspection/Re-pruning interval _____

Additional information _____

Cost Estimate _____ **Signature** _____ **Date** _____

This is a proposal for pruning only, it should not be considered a tree risk assessment, if a full risk assessment is desired, contact me for a price and details. Arborist will attempt to remove all of the specified branches, however it cannot be guaranteed that all of the described branches will be seen and removed. Arborists in the tree have the discretions to modify these specifications depending on conditions they observe. Every attempt will be made to deliver this service on the specified date or season, but if weather conditions do not permit, the service may be delayed.

This document was developed by the International Society of Arboriculture in 2019 and is available for all to modify or use in their business.

Glossary

ANSI A300—in the United States, industry-developed, national consensus standards of practice for tree care.

ANSI Z133—in the United States, industry-developed, national consensus safety standards of practice for tree care.

arboriculture—practice and study of the care of trees and other woody plants in the landscape.

arborist—an individual engaged in the profession of arboriculture who, through experience, education, and related training, possesses the competence to provide for or supervise the management of trees and other woody plants.

BS3998—in the United Kingdom, industry-developed, national consensus standards of practice for tree care.

bark inclusion—see *included bark*.

best management practices—best-available, industry-recognized courses of action, in consideration of the benefits and limitations, based on scientific research and current knowledge.

branch—a shoot or stem arising from another branch or stem.

branch bark ridge—raised strip of bark at the top of a branch union where the growth and expansion of the trunk or parent stem and adjoining branch push the bark into a ridge.

branch collar—the area of swelling at the union between a parent stem and a smaller branch.

branch protection zone—chemically and physically modified tissue within the trunk and parent branch at the base of a smaller, subordinate branch that retards the spread of discoloration and decay from the subordinate stem into the trunk or parent branch.

branch removal cut (previously termed a *thinning cut* or *removal cut*)—pruning cut that removes the smaller of two branches at a union, or a parent stem. Removal cuts retain the branch bark ridge or branch collar and do not create a stub.

cambium—thin layer(s) of meristematic cells that give rise (outward) to the phloem and (inward) to the xylem, increasing stem and root diameter.

clean—arboricultural term used to describe selective pruning to remove one or more of the following: dead, diseased, infested, and/or broken branches.

climbing spurs—sharp, pointed devices strapped to a climber's lower legs to assist in climbing poles or trees being removed. Also called *spikes*, *gaffs*, *irons*, *hooks*, or *climbers*.

closure (wound closure, close)—the process in a woody plant by which woundwood grows over a pruning cut or injury.

codominant stem/codominant branch—two or more branches of similar diameter arising from a common union and lacking a collar.

compartmentalization—natural defense process in trees by which chemical and physical boundaries are created that act to limit the spread of disease and decay organisms.

crown—upper part of a tree, measured from the lowest branch, including all the branches and foliage.

culm—the stem of a grass or sedge, including the woody, hollow aerial stem of bamboo.

decay—(1) (*noun*) an area of wood that is undergoing decomposition. (2) (*verb*) decomposition of organic tissues by fungi or bacteria.

directional pruning—selective removal of branches to guide and/or discourage growth in a particular direction.

dominant leader/trunk/stem—the stem that grows much larger than all other stems and branches.

frond—large, divided leaf structure found in palms and ferns.

espalier—a pruning system that trains plants to grow within a plane, such as along a wall or a fence.

flush cut—a pruning cut that removes the branch bark ridge and/or branch collar, damaging the trunk or parent branch.

good structure/architecture/form—branch and trunk architecture resulting in a canopy form that resists failure.

heading—a pruning cut that removes a branch or stem between nodes (leaving a stub), to a bud, or to a live branch that is less than one-third the diameter of the branch or stem being removed.

included bark—bark that becomes embedded in a union (crotch) between branch and trunk or between codominant stems. Causes a weakness in the union.

lateral—a branch arising from a larger stem or branch.

leader—primary terminal shoot or trunk of a tree. Large, usually upright stem. A stem that dominates a portion of the crown by suppressing lateral branches.

lion-tailing—excessive removal of lower or interior branches on main scaffolds that results in a concentration of growth and foliage at branch ends. It is considered an unacceptable practice.

live crown ratio—the ratio of the height of the crown containing live foliage to the overall height of the tree.

mature trees—trees that have reached at least 75 percent of their typical final height and spread.

mechanical pruning—pruning with heavy equipment (not handheld) fitted with power saws or other cutting devices (e.g., saws mounted on booms or suspended from a helicopter).

natural growth habit—the inherent characteristic growth pattern and habit (form) of a tree, shrub, or vine in its current location.

node—slightly enlarged growth point on a stem where buds, shoots, and leaves arise.

palm—monocotyledonous plant of the Arecaceae family, generally with one or more unbranched trunks, with fronds emanating from a meristem at the top of the trunk.

palm frond skirt—one or more year's accumulation of dead and drooping fronds at the bottom of the canopy and along the trunk of a palm.

parent branch or stem—a tree trunk or branch from which other branches or shoots grow.

peeling—(1) removing dead petiole bases by cutting into live tissue (synonymous with shaving, skinning, or sanding). Not an acceptable practice. (2) the tearing downward of bark or sapwood from the trunk or parent branch when the branch or stem was not precut.

petiole—stalk or support axis of a leaf.

permanent branches—branches that form the architectural framework of a tree. In structural pruning of trees, branches that will be left in place.

photosynthesis—process in green plants by which light energy is used to form sugar from water and carbon dioxide.

phytotoxic—term to describe a compound that is poisonous to plants.

pleaching—pruning system that trains one or more plants to achieve a desired shape or form through a combination of pruning and interweaving or tying small branches to one another, or to a preformed frame.

pollarding—a semiformal pruning system that maintains crown size by initial heading of branches on young trees or young portions of older trees, followed by removal of sprouts to their point of origin at appropriate intervals without disturbing the resulting pollard head.

pruning—the selective removal of plant parts to achieve defined objectives.

reaction zone—natural boundary formed chemically within a tree to separate damaged wood from existing healthy wood. Important in the process of compartmentalization.

reduce—reduce the length of a stem or branch using a reduction cut.

reduction cut—a pruning cut that removes the larger of two or more branches or stems, or one or more codominant stem(s), to a live lateral branch, typically at least one-third the diameter of the stem or branch being removed. Reduction cuts are referred to as *branch reduction*, *reduction*, or *reduce* (previously called *cutting to a lateral*).

rejuvenation—removal of overmature, dead, or dying stems of a shrub, near the ground, to stimulate new stem development.

restoring—the process of pruning to improve the structure, form, and appearance of trees that have been improperly trimmed, vandalized, or damaged.

retrenchment—crown reduction process involving one or more pruning events to manage loss of support or crown decline.

sanitation pruning—the removal of branches that are infested with insects or disease pathogens.

scaffold branch—a branch that is among the largest diameter on the tree and will remain on the tree to maturity.

shearing—cutting leaves, shoots, and branches to a desired plane, shape, or form, using tools designed for that purpose, as with topiary and pleaching pruning systems.

shoot—new stem or branch growth on a plant.

specifications—detailed plans, requirements, prescriptions, and statements of particular procedures used to define, measure, and guide work.

stem—woody structure bearing foliage and buds that gives rise to other stems (branches).

starch—chain of sugar molecules linked together that serves as a form of energy storage in plants.

structural pruning—pruning to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems.

stub—portion of a branch or stem remaining after a heading cut, branch breakage, or branch death.

subordination—the removal of the end of a branch or stem to slow its growth relative to its parent, or to a favored branch or stem.

sucker—shoot arising from the roots. Contrast with *watersprout*.

throwline—thin, lightweight cord attached to a throwbag or throwing ball used to set climbing or rigging lines in trees.

topiary—a formal pruning system that uses a combination of pruning, supporting, and training branches to orient a plant into a desired shape.

topping—the reduction of tree size by heading large, live branches and leaders without regard to long-term tree health or structural integrity.

tree—a woody perennial plant with a single or multiple trunks, which typically develop a mature size of over several inches in diameter and 10 feet (3m) or more in height.

trunk—the main stem or stems of a tree.

union (crotch)—the junction of stem and branch or between stems.

watersprout (sprout)—upright, epicormic shoots arising from the trunk or branches of a plant above the root graft or soil line. Incorrectly called a *sucker*.

wound—an opening that is created when the bark of a live branch or stem is cut, penetrated, damaged, or removed.

wound dressing—compound applied to tree wounds or pruning cuts.

ZTV—the German industry-developed, national standards of practice for tree care.

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