Exhibit K

American National Standard

ANSI® Z133-2017

for Arboricultural Operations—
Safety Requirements

ISA
International Society of Arboriculture

Approved American National Standard
ANSI

ANSI®
Z133 - 2017
Revision of
ANSI Z133-2012

American National Standard for Arboricultural Operations—

Safety Requirements

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Approved by American National Standards Institute (ANSI) on 5 October 2017

ISBN 978-1-881956-72-3

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Printed by Martin One Source, Champaign, Illinois
10 9 8 7 6 5 4 3 2 1
KA/17-10/2000

American National Standard

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FOREWORD

(This foreword is not part of American National Standard Z133-2017).

This standard was developed for the arboriculture industry under the procedures of the American National Standards Institute by the Accredited Standards Committee on Safety Requirements for Arboricultural Operations, Z133. The secretariat of the Z133 Committee is held by the International Society of Arboriculture.

The Accredited Standards Committee Z133 was organized on 4 April 1968, in response to efforts by Mrs. Ethel M. Hugg of Johnstown, New York. Mrs. Hugg's son had died while trimming trees, and this tragic incident caused her to write to federal and state authorities and to various other organizations in an attempt to have measures initiated that would make tree trimming safer.

The Z133 Committee was organized with the National Arborist Association (now the Tree Care Industry Association) as secretariat. Committee delegates included representatives of industry, labor, the academic community, government, equipment manufacturers, insurance carriers, and other interested experts. The International Shade Tree Conference (now the International Society of Arboriculture) became the secretariat of the committee in November 1969.

The initial standard was unanimously adopted by the committee on 14 July 1971, and was approved as an American National Standard on 20 December 1972.

The Z133 Committee continues to monitor arboriculture safety performance, providing interpretation and clarification of the intent of the requirements in the standard and for any adjustments or revisions of the standard.

Portions of the safety standard have been adopted by the Occupational Safety and Health Administration (OSHA).

The committee recognizes that manufacturers provide instruction manuals regarding operation of their products, but these manuals are not dispositive of whether a particular risk or hazard exists.

This standard is reviewed on a continual basis by the committee and reviewed by the public. Revisions have occurred in 1978, 1982, 1987, 1994, 2000, 2006, and 2012. The 2017 revision has undergone significant changes. Editorial and substantive changes have been made as a result of committee review and public comment.

There are ten annexes in this standard. All ten are informative and are not considered part of this standard.

Suggestions for improvement of this standard are welcome. All official comments must be made online using the form at www.isa-arbor.com/Z133. For general comments or questions, e-mail the International Society of Arboriculture at Z133@isa-arbor.com.

This standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Safety Requirements for Arboricultural Operations, Z133. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time the Z133 Committee approved this standard, it included the following members:

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1 GENERAL

1.1 Scope

This standard contains **arboriculture** safety requirements for pruning, repairing, maintaining, and removing trees; cutting brush; and for using equipment in such operations. (Note: Terms specific to the safe practice of arboriculture appear in boldface type at first use and are defined in Annex A, Glossary of Terms for ANSI Z133.)

1.2 Purpose

The purpose of this document is to provide safety standards for **arborists** and other workers engaged in arboricultural operations. It is intended as a guide to federal, state, and local authorities in drafting their regulations and may be adopted in whole or in part.

1.3 Application

This standard is intended to serve as a reference for safety requirements that will apply to all **employers** or persons engaged in the business, trade, or performance of arboriculture for pay, operations of which include, but are not limited to, tree pruning, repairing, or maintaining; removing trees; cutting brush; or performing pest or soil management.

This standard may require situational modifications in response to personnel emergencies and is not intended to limit the options available to emergency responders.

1.4 Responsibilities of the Employee

Each person (employee or otherwise) **shall** be responsible for his/her own safety while at work and shall comply with the appropriate federal or state occupational safety and health standards and all rules, regulations, and orders that are applicable to his/her own actions and conduct.

2 NORMATIVE REFERENCES

This standard contains references to other American National Standards and federal regulations, which, through reference in this text, constitute provisions of this American National Standard. See Annex D, Additional Resources, for a list of these and other applicable informative references. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex D.

Because of the many specialized procedures utilized during arboricultural operations, it must be emphasized that exceptions to provisions of these standards may be acceptable and that flexibility and/or a decision as to the applicability of these standards to professional operations may be required.

3 GENERAL SAFETY REQUIREMENTS

3.1 General

3.1.1 Tools and equipment used in arboricultural operations shall comply with applicable OSHA regulations and/or ANSI standards. In the absence of applicable OSHA/ANSI guidance, the requirements of this standard shall be followed.

3.1.2 Employers shall instruct their employees in the proper use, inspection, and maintenance of personal protective equipment (PPE), tools (hand and powered), and other equipment, including ropes and lines.

3.1.3 Employers shall require that appropriate safety-related work practices be followed in accordance with applicable OSHA and consensus standards, including, but not limited to ANSI and ASTM. As applicable, manufacturers' recommendations **should** be followed. See Section 5, Safe Use of Vehicles, Mobile, and Towed Equipment Used in Arboriculture, for specific standards regarding vehicles and mobile equipment.

3.2 Emergency Procedures and Readiness

3.2.1 All personnel engaged in arboricultural operations shall be instructed in the correct procedures for emergency response, including 911 calls and other applicable emergency phone numbers.

3.2.2 The employer shall provide and maintain a first-aid kit that meets the requirements of ANSI Z308.1, with contents appropriate for the type of job and number of workers.

3.2.3 Instruction shall be provided in the identification, preventive measures, and first-aid treatment of common poisonous plants (poison ivy, poison oak, and poison sumac), stinging and biting insects, and other pests found in the area in which work is to be performed.

3.2.4 Employees who may be faced with a rescue decision shall receive training in emergency response and rescue procedures appropriate and applicable to the work to be performed, as well as training to recognize the hazards inherent in rescue efforts (see Annex F, Aerial Rescue Flowchart).

3.2.5 For field crews involving two or more workers at a work location, at least two workers trained in first aid/CPR shall be available. However, only one trained person need be available if all new employees are trained in first aid within three months of their hiring dates.

3.3 Personal Protective Equipment (PPE)

3.3.1 Personal protective equipment (PPE), as outlined in this section, shall be required when there is a reasonable probability of injury or illness that can be prevented by such protection.

3.3.2 The employer shall assess the worksite to determine if hazards are present or are likely to be present and what type of personal protective equipment is required.

3.3.3 Training shall be provided on the inspection, use, care, maintenance, fit, and replacement of personal protective equipment.

3.3.4 Workers engaged in arboricultural operations shall wear head protection (helmet) that conforms to ANSI Z89.1. Class E helmets shall be worn when working in **proximity** to **electrical conductors** in accordance with ANSI Z89.1. Workers shall not place reliance on the **dielectric** capabilities of such helmets.

3.3.5 Hearing protection provided by the employer shall be worn when it is not practical to decrease or isolate noise levels that exceed acceptable standards. The employer shall provide employees protection against the effects of noise exposure when sound levels exceed an 8-hour, time-weighted average (TWA) of 85 decibels (dB).

3.3.6 Eye protection shall comply with ANSI Z87.1 and shall be worn when engaged in arboricultural operations.

3.3.7 Clothing and footwear appropriate to the known worksite hazards shall be **approved** by the employer and worn by the employee.

3.3.8 Cut-resistant **leg protection** that meets or exceeds ASTM F1414 and ASTM F1897 shall be worn while operating a chain saw during ground operations. Cut-resistant leg protection shall be maintained in accordance with manufacturers' recommendations.

3.3.9 Face protection shall comply with applicable federal regulations as well as with ANSI Z87.1.

3.3.10 Respiratory protection shall comply with applicable federal regulations and with ANSI Z88.2.

3.4 Job Briefing and Worksite Setup

3.4.1 A **qualified arborist** shall determine whether **direct supervision** is needed on a worksite.

3.4.2 Before **digging**, underground utilities shall be marked by utility-locating services.

3.4.2.1 Many utility-based locating services will not locate privately owned underground lines, such as, but not limited to, irrigation, electrical wires, and propane lines. Further resources or research may be necessary to locate underground utilities on private properties.

3.4.3 A **job briefing** shall be performed by the qualified arborist in charge before the start of each job. The briefing shall be communicated to all affected workers. An employee working alone need not conduct a job briefing. However, the employer shall ensure that the tasks are being performed as if a briefing were required.

3.4.4 Before commencing operations, a communication protocol shall be established or reviewed between arborists aloft and personnel working on the ground. Verbal communication by voice or radio shall employ a command-and-response (C&R) protocol. "Stand Clear" as the "C" from aloft and "Clear" as the "R" from the ground are examples. Hand signals or whistles may also be used. Eye contact with, or line-of-sight between, the arborist aloft and the ground person should also be established when communicating.

3.4.5 The arborist in charge shall establish a plan to safely manage the worksite. Communications among arborists aloft and other workers on the ground shall be established before commencing operations. Predetermined, non-verbal communication such as whistles, two-way hand signals, or radios may also be used.

3.4.6 When dropping or lowering trunks, branches, fruit, or equipment, a landing area (**drop zone**) should be designated.

3.4.6.1 People and valuable objects shall be protected or excluded from the drop zone when active.

3.4.6.2 A visible drop zone may be designated as an aid to avoidance of falling objects.

3.4.7 An inspection shall be made by a qualified arborist to determine whether an **electrical hazard** exists before performing arboricultural operations.

3.4.8 A qualified arborist shall visually inspect the tree, including the root collar and the area immediately surrounding the tree, for hazards before anyone climbs, otherwise enters, or performs any work on the tree.

3.4.9 When definite indicators of decay, weakly attached branches, or dead bark are seen, the qualified arborist shall determine if the tree can withstand the forces to be applied during the work.

3.4.9.1 If there is question as to the condition of the tree, relative to the task to be performed, work shall not commence until a more thorough assessment can be made.

3.4.10 A second arborist, an arborist trainee, or other worker trained in emergency procedures shall be within visual or voice communication during arboricultural operations above 12 feet (3.65 m) that are not subject to the requirements of Subsection 4.3.9.

3.5 Traffic Control

3.5.1 Traffic and pedestrian control around the worksite shall be established prior to the start of all arboricultural operations.

3.5.2 Arborists and other workers having specific **temporary traffic control zone** responsibilities shall be trained in temporary traffic control techniques, device usage and placement, and how to work next to traffic in a manner that minimizes their exposure.

3.5.3 Arborists and other workers exposed to risks of moving roadway traffic shall wear high-visibility safety apparel meeting the requirements of ANSI/ISEA 107.

3.5.4 The temporary traffic control zone should impede the flow of vehicular traffic as little as possible. Arborists and other workers should use the necessary devices that get the road user's attention and provide positive direction in accordance with the Manual on Uniform Traffic Control Devices (MUTCD).

3.5.5 Pedestrians should have separate movement from the worksite and vehicular traffic, including bicycles, with a safe, convenient, and accessible path.

3.6 Fire Protection

3.6.1 All personnel shall be instructed in the use and location of vehicle-mounted fire extinguishers.

3.6.2 Equipment shall be fueled only:

(a) when the engine has been shut down;

(b) from **approved containers**; and

(c) at least 10 feet (3.05 m) from any operating equipment.

Spilled fuel shall be cleaned up before restarting.

3.6.3 Flammable liquids shall be stored, handled, and dispensed from approved and clearly marked containers.

3.6.4 Equipment shall not be operated within 10 feet (3.05 m) of areas in which refueling has recently taken place.

3.6.5 Smoking shall be prohibited when working around or handling flammable liquids or while wearing clothing contaminated by fuel.

3.6.6 Clothing contaminated with fuel shall be changed, removed, or replaced as soon as possible.

3.6.7 Open flame and other sources of ignition shall be avoided.

3.6.8 Dead and/or combustible material shall be kept clear of hot and/or operating equipment.

3.6.9 Where required, all internal or external combustion engines shall be equipped with a spark arrester that meets the requirements established by SAE Standard J335 or USDA Forest Service Specification 5100-1. Federal requirements are explained in 36 CFR 261.52.

4 ELECTRICAL HAZARDS

4.1 General

4.1.1 All applicable requirements in Section 3, General Safety Requirements, shall apply to this section.

4.1.2 The employer shall train each employee that all overhead and underground electrical conductors, guy wires, pole grounds, and communication wires and cables shall be considered energized with potentially fatal voltages.

4.1.3 Arborists' training and degree of training in electrical hazards shall be determined by the risk to the employee for hazard(s) involved.

4.1.4 All arborists and other workers shall be instructed that:

(a) the human body is **conductive** and poses little resistance to electric current and will provide a path for the flow of electricity to a **grounded** object or to the ground itself;

(b) **direct contact** or **indirect contact** (**phase-to-ground** contact) with an electrical conductor, energized tree limb, tool, or equipment, or other energized object may lead to electric shock, significant injury, or death;

(c) the woody parts of trees, leaves, branches, needles, palm fronds, etc., are conductive;

(d) simultaneous contact with two separate energized conductors (**phase-to-phase** contact) will cause electric shock that may result in serious or fatal injury;

(e) electrical shock may occur as a result of **ground fault** when a person stands near a grounded object that becomes energized (e.g., an uninsulated part of an **aerial device** comes into contact with a conductor); and

(f) in the event of a downed energized electrical conductor or energized grounded object (e.g., guy wires or pole grounds), there exists the hazard of touch and **step potential**.

4.1.5 An inspection shall be made by a qualified arborist to determine whether an electrical hazard exists before climbing, otherwise entering, or performing work in or on a tree.

4.1.6 When determining the presence of an electrical hazard, consideration shall be given to the potential movement of an electrical supply line due to wind, load sag, or other factors that affect the line's position in relation to the work.

4.1.7 Arborists not qualified by training and experience to work within 10 feet (3.05 m) of electrical conductors shall maintain at all times the **minimum approach distances (MAD)** shown in Table 1, measured radially.

4.1.8 Arborists should climb on the side of the tree that is away from energized electrical conductors.

4.1.9 Climbers' body, gear, and their conductive equipment shall be maintained at the required minimum approach distance (MAD) or greater, shown in Tables 1, 2, or 3, as applicable.

4.1.10 The climber's tie-in point should be above the climber's work position and located in such a way that a slip would swing the arborist away from any energized electrical conductor or other identified hazard.

4.1.11 A conductive rope may not be used within the minimum approach distances (MAD) shown in Tables 1, 2, or 3, as applicable.

4.1.12 Portable **ladders** shall not have conductive side rails if they are used where the employee or the ladder could contact exposed energized parts.

4.1.13 Ladders, **platforms**, and aerial devices, including **insulated** aerial devices, shall be subject to minimum approach distances in accordance with Tables 1, 2, or 3, as applicable.

Table 1. Minimum approach distances to energized conductors for arborists not qualified by training and experience to work within 10 feet (3.05 m) of electrical conductors.

Nominal Voltage (Phase-to-Phase)*	Minimum Approach Distance (MAD)	
kV	ft-in	m
50.0 and less	10-00	3.048
50.1 to 72.5	11-00	3.353
72.6 to 121.0	12-08	3.861
138.0 to 145.0	13-04	4.064
161.0 to 169.0	14-00	4.267
230.0 to 242.0	16-08	5.080
345.0 to 362.0	20-08	6.299
500.0 to 550.0	26-08	8.128
785.0 to 800.0	35-00	10.668

*Exceeds phase-to-ground per 29 CFR 1910.333.

4.1.14 Due to the hazards of step and touch potential, if the distance between the aerial device and energized conductor(s) is unintentionally less than the required minimum approach distance (MAD), workers on the ground shall move away and remain clear of the aerial-device vehicle and attached equipment (e.g., chipper) until the required MAD is re-established.

4.1.15 Emergency response to an electric contact shall be performed in accordance with Section 3.2, Emergency Procedures and Readiness.

4.1.16 Arboricultural operations in proximity to energized electrical conductors shall not be performed during adverse weather conditions, such as thunderstorms, high winds, snow storms, or ice storms.

4.2 Working in Proximity to Electrical Hazards – Incidental Line Clearance (29 CFR 1910, Subpart S)

4.2.1 The items contained in Section 4.1, General, shall always be included in the review of this section.

4.2.2 Workers shall be trained on safety-related work practices that protect employees against the voltage level to which they are exposed.

4.2.3 Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts and shall be consistent with the nature and extent of the electrical hazards present.

4.2.4 Training for qualification of qualified **incidental line clearance** arborists requires a minimum of:

(a) the skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;

(b) the skills and techniques necessary to determine the nominal voltage of exposed live parts; and

(c) the minimum approach distances (MAD) specified in Table 2 and the corresponding voltages to which the qualified person will be exposed.

4.2.5 Before work is performed within the minimum approach distance (MAD) without insulated tools, overhead energized lines shall be de-energized. It shall be the responsibility of the system owner/operator of the electrical system to make the system safe.

4.2.6 When a qualified incidental line-clearance arborist is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person shall not approach or take any conductive object closer to exposed energized parts than shown in Table 2.

4.2.7 Branches and other parts of trees within the minimum approach distances (MAD) which have been browned or charred by past electrical arcing or contact should be considered likely to become re-energized without warning and thus should be treated as energized. Climbing of trees in such condition should be avoided.

4.2.8 Tools that are not rated as insulated for the voltage to which they are exposed shall be considered conductive.

Table 2. Approach distances for incidental line clearance–alternating current.

Voltage Range (Phase-to-Phase)*	Minimum Approach Distance (MAD)	
kV	**ft-in**	**m**
0.300 and less	*Avoid contact*	*Avoid contact*
0.301 to 0.750	1-06	0.457
0.751 to 5.0	2-09	0.838
5.1 to 15.0	2-10	0.864
15.1 to 36.0	3-04	1.016
36.1 to 46.0	3-08	1.118
46.1 to 72.5	4-04	1.321
72.6 to 121.0	12-08	3.861
138.0 to 145.0	13-04	4.064
161.0 to 169.0	14-00	4.268
230.0 to 242.0	16-08	5.080
345.0 to 362.0	20-08	6.300
500.0 to 550.0	26-08	8.128
785.0 to 800.0	35-00	10.668

*Exceeds Table S-5 29 CFR 1910.333.

4.3 Working in Proximity to Electrical Hazards – Utility Line Clearance (29 CFR 1910.269)

4.3.1 The items contained in Section 4.1, General, shall always be included in the review of this section.

4.3.2 The employer shall verify that each line-clearance arborist is qualified to work within proximity to electrical hazards that the arborist is exposed to and has been trained in the following topics:

(a) To be familiar with safety-related work practices, procedures, and other requirements that pertain to his or her job assignments.

(b) On emergency and work-related rescue procedures that are related to his or her work and are necessary for the safety of the worker.

4.3.3 Qualified line-clearance arborists shall also be trained and competent in:

(a) The skills and techniques necessary to distinguish exposed, energized parts from other parts of electric equipment.

(b) The skills and techniques necessary to determine the nominal voltage of exposed energized parts.

(c) The MAD specified in Table 3 and the corresponding voltages to which the qualified line-clearance arborist will be exposed and the skills and techniques necessary to maintain those distances, for the nominal voltage present.

4.3.4 The employer shall ensure that each employee has demonstrated proficiency in the work practices involved before that employee is considered as having completed the training.

4.3.5 When **qualified line-clearance arborist trainees** are assigned to work where an electrical hazard exists, the qualified line-clearance arborist trainees shall be under the direct supervision of qualified line-clearance arborists.

4.3.6 **Qualified line-clearance arborists** and qualified line-clearance arborist trainees performing **line clearance** after a storm or under similar conditions shall be trained in the hazards associated with this type of work and in the recognition of the hazards of step potential.

4.3.7 Line-clearance operations shall be suspended when adverse weather conditions or emergency conditions develop involving energized electrical conductors. Electrical system owners/operators shall be notified immediately.

4.3.8 When performing line-clearance work for the electrical system owner/operator (**host employer**) – it shall be the responsibility of the contract employer receiving host utility information to communicate it and any hazardous conditions relevant to the affected workers performing the affected work.

(a) Before work begins, the contract employer and the host employer shall coordinate their work rules and procedures so that each employee of the contract employer and the host employer is protected.

(b) Before work begins, the contract employer shall advise the host employer of any unique hazardous conditions presented by the contract employer's work.

(c) The contract employer shall advise the host utility/employer of any unanticipated hazardous conditions of the electrical system found during the contract employer's work. This information shall be provided to the host utility within two working days after discovering the hazardous condition.

4.3.9 A second qualified line-clearance arborist or line-clearance arborist trainee (with a minimum of training in emergency procedures), shall be within unassisted voice communication and should be within visual contact during line-clearance operations aloft when a qualified line-clearance arborist or line-clearance arborist trainee must approach closer than 10 feet (3.05 m) to any energized electrical conductor in excess of 750 **volts** (**primary conductor**) or when:

(a) branches or limbs are being removed, which cannot first be cut (with an insulated pole pruner/pole saw) to sufficiently clear electrical conductors, so as to avoid contact; and/or

(b) roping is required to remove branches or limbs from such electrical conductors.

4.3.10 Insulating pruning tools shall be designed and constructed to withstand the minimum testing, as outlined in Annex J, Live-Line Tools.

4.3.11 Qualified line-clearance arborists and line-clearance arborist trainees shall maintain minimum approach distances from energized electrical conductors in accordance with Table 3.

4.3.12 If the minimum approach distance (shown in Table 3) cannot be maintained during the arboricultural operations, the qualified line-clearance arborist shall request that the **electrical system owner/operator's** designated supervisor in charge coordinate communications and operations between the electrical system owner/operator and the qualified line-clearance arborist to **mitigate** the electrical hazard. Mitigation options should include all safe, OSHA-compliant, and practical work methods, and, where necessary, **de-energizing**, **testing**, isolating, and grounding the electrical conductors by the electrical system owner/operator (see Annex H, Electrical Hazard Abatement). The designated electrical system owner/operator employee and the designated qualified line-clearance arborist in charge shall confirm that protective ground(s) have been installed as close as is practical to the line-clearance work to be performed to prevent hazardous differences in electrical potential.

4.3.13 Branches that are contacting exposed energized conductors or equipment, or that are within the distances specified in Table 3, may be removed only through the use of insulating equipment and/or tools.

4.3.14 Branches and other parts of trees within the minimum approach distances (MAD) which have been browned or charred by past electrical arcing or contact, should be treated with caution. The following steps should be followed when this condition is present:

(a) Climbing of trees in such condition should be assessed by a qualified line-clearance arborist and supervisor to determine whether or not an electrical hazard exists and mitigation is necessary before performing arboricultural operations.

(b) The arborist in charge shall establish a plan to safely manage the work.

(c) Work strategies, in accordance with contract employer and host utility work rules, shall be employed so that each employee of the contract employer and the host employer is protected (see Subsection 4.3.12 and Annex H, Electrical Hazard Abatement, on determining an electric hazard mitigation plan).

4.3.15 Rubber gloves, with or without leather or other protective covering, shall not be considered as providing any measure of safety from electrical hazards.

4.3.16 Footwear, including lineman's overshoes or those with electrical-resistant soles, shall not be considered as providing any measure of safety from electrical hazards.

Table 3. Minimum approach distances (MAD) from energized conductors for qualified line-clearance arborists and qualified line-clearance arborist trainees.

Voltage Range (Phase-to-Phase)	Altitude Correction Factor Sea Level to 5,000 ft (0–1,524 m)* Phase-to-Ground		Altitude Correction Factor 5,000 to 10,000 ft (1,524–3,048 m)* Phase-to-Ground		Altitude Correction Factor 10,000 to 14,000 ft (3,048–4,267 m)* Phase-to-Ground	
kV	ft-in	m	ft-in	m	ft-in	m
0.050 to 0.300	*Avoid contact*		*Avoid contact*		*Avoid contact*	
0.301 to 0.750	1-02	0.356	1-04	0.407	1-06	0.458
0.751 to 5.0	2-03	0.686	2-06	0.762	2-09	0.839
5.1 to 15.0	2-03	0.686	2-07	0.788	2-10	0.864
15.1 to 36.0	2-08	0.813	3-01	0.940	3-04	1.016
36.1 to 46.0	2-11	0.889	3-04	1.016	3-08	1.118
46.1 to 72.5	3-06	1.067	4-00	1.220	4-04	1.321
72.6 to 121.0	3-11	1.194	4-06	1.372	4-10	1.474
121.1 to 145.0	4-06	1.372	5-02	1.575	5-07	1.702
145.1 to 169.0	5-01	1.550	5-09	1.753	6-03	1.905
169.1 to 242.0	7-00	2.134	7-11	2.413	8-07	2.617
242.1 to 362.0	11-09	3.582	13-06	4.115	14-07	4.445
362.1 to 420.0	14-08	4.471	16-09	5.106	18-02	5.538
420.1 to 550.0	17-06	5.334	20-00	6.096	21-08	6.604
550.1 to 800.0	23-09	7.239	27-02	8.281	29-05	8.967

*From 29 CFR 1910.269 Tables R-6 & R-7 altitude corrected (R-5) for 1,500 m, 3,000 m, & 4,200 m.

5 SAFE USE OF VEHICLES, MOBILE, AND TOWED EQUIPMENT USED IN ARBORICULTURE

5.1 Vehicles and Mobile Equipment

5.1.1 All applicable requirements in Section 3, General Safety Requirements, shall apply to this section.

5.1.2 Pre- and post-trip inspections shall be performed on all equipment. Inspections and operational checks shall be performed in accordance with applicable Federal Motor Carrier Safety Regulations (FMCSR), and state and local requirements.

5.1.2.1 If an inspection reveals a defect that could affect the safe operation of the equipment, the equipment shall be removed from service. To prevent operating the equipment prior to repairs, the defects shall be documented and documentation made visible for other operators. The inspection record shall not be removed until the repairs have been made and the equipment is safe to use.

5.1.3 When the operators' view of hazards may be obstructed, walk-through inspections of the area where equipment will travel shall be performed. If hazards cannot be removed, the hazards shall be flagged, marked, or otherwise identified, and the operator shall be made aware of the hazards prior to proceeding. If a written pre-job briefing exists for the work being completed, identified hazards shall be documented.

5.1.4 Equipment shall be equipped and maintained with manufacturers' safety devices, instructions, decals, and safeguards.

5.1.5 Manufacturers' preventive maintenance inspections and parts replacement procedures should be followed.

5.1.6 No part of the body shall be used to locate or stop hydraulic leaks.

5.1.7 Equipment shall be inspected, operated, and maintained only by employer-**authorized** personnel.

5.1.8 Material and equipment carried on vehicles shall be properly stored and **secured** in compliance with the design of the equipment and in accordance with federal, state, or local regulations.

5.1.9 Manufacturer-provided slip/skid-resistant surfaces shall be maintained.

5.1.10 Safety seatbelts, when provided by the manufacturer, shall be worn by the driver and passenger(s) while the vehicle is in motion.

5.1.11 Riding or working outside or on top of equipment shall not be permitted unless the equipment is specifically designed for that purpose.

5.1.12 Hoisting or lifting equipment mounted on vehicles shall be used within rated capacities as stated by the manufacturers' specifications.

5.1.13 Equipment with an obstructed view to the rear, particularly those with towed equipment, should be backed up only when absolutely necessary. The vehicle shall not be backed up unless the vehicle has a reverse signal alarm audible above the surrounding noise level or when a **spotter** signals that it is safe to do so, or, immediately before backing up, the driver determines through a visual walk-around inspection that there are no people or obstructions in the path of the vehicle.

5.1.14 When equipment is left unattended, attachments should be stowed, cradled, or lowered to the ground; keys shall be removed from the ignition; the wheels chocked; and, if applicable, the parking brake applied.

5.1.15 When performing maintenance or repairs, except where manufacturers' procedures require otherwise:

(a) equipment shall be turned off;

(b) keys shall be removed from the ignition;

(c) all rotating parts and moving parts shall be stopped and secured, if applicable; and

(d) all sources of energy, including, but not limited to: mechanical, electrical, hydraulic, pneumatic, chemical, and thermal energy shall be verified to be released.

Defects or malfunctions affecting the safe operation of equipment shall be corrected before such equipment is placed into use (see Annex C, General Safety Procedures That Apply to All Tree Work).

5.1.16 When towing:

5.1.16.1 Safety chains shall be crossed under the tongue of the equipment being towed and adjusted to the appropriate length. The safety chains shall not be twisted or knotted when connecting or when connected to the tow vehicle.

5.1.16.2 Connecting links and repair links shall be of the same size and grade as the safety chain(s) being used.

5.1.16.3 All coupling devices shall be in place and in proper working condition (e.g., pins, electrical connections, emergency break-away devices). Equipment shall meet the towing capacities necessary for the intended load.

5.1.16.4 Manufacturer towing capacity and gross combination weight rating (GCWR) shall not be exceeded except where permitted by law.

5.1.17 Prior to being detached, towed equipment shall be chocked or otherwise secured in place.

5.1.18 Precautions should be taken to ensure that exhaust systems do not present a fire hazard.

5.1.19 Equipment operated off-road shall be operated in the appropriate gear and speed relative to the operating environment.

5.1.20 Operator protective structures shall meet the requirements of the applicable Society of Automotive Engineers (SAE) standard.

5.1.21 Equipment body props shall be installed and used when the dump body is raised and workers need to access the area underneath. The equipment props should be accessible without reaching between the raised part of the equipment and the chassis or body of the equipment.

5.1.22 Drivers shall know and not exceed the gross vehicle weight rating (GVWR) and/or gross combination weight rating (GCWR) of any vehicle and towed equipment prior to moving the equipment.

5.1.23 Drivers shall know the height of the vehicle and any towed equipment prior to moving the vehicle or towed equipment and shall not attempt to drive under structures lower than the vehicle height.

5.2 Aerial Devices

5.2.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.2.2 Before the aerial device is set up for use, the worksite shall be surveyed for hazards, such as:

- insufficient supporting surfaces, such as soft ground
- ditches
- excessive slopes, drop-offs, curbs, and floor obstructions
- debris
- overhead obstructions and electrical conductors
- weather conditions
- presence of unauthorized persons
- road or worksite traffic
- subsurface chambers, such as underground utility components or septic systems

5.2.3 Aerial devices or aerial ladders shall not be used as cranes or hoists to lift, support, or lower materials or tree parts unless they were specifically designed by the manufacturer to do so.

5.2.4 A minimum of two **wheel chocks** shall be set before using an aerial device unless the device has no wheels on the ground or is designed for use without chocks.

5.2.5 **Outriggers** or stabilizers shall be used if manufacturers' instructions require their use. All outriggers shall be properly set on pads before the aerial device is moved from the boom rest (cradle).

5.2.6 The operator of the outrigger controls shall ensure adequate clearance exists and give warning to all workers on the worksite prior to lowering outriggers.

5.2.7 Aerial devices shall be provided with fall-protection anchor(s) meeting design requirements of the ANSI/SIA A92.2 standard on which to secure an approved system of personal fall protection which shall be worn by the operator(s) whenever aloft.

5.2.7.1 All fall protection shall be worn and adjusted in accordance with manufacturer specification.

5.2.7.2 The **carabiners** and **snap hooks** used as part of a fall-arrest system shall have a 3,600-pound-rated gate. Carabiners and snap hooks shall not be linked together unless designed to do so and accepted by the manufacturer.

5.2.8 Combined loads shall not exceed rated lift capacities. Load ratings shall be permanently posted on aerial devices in accordance with ANSI/SIA A92.2 or A92.5, as applicable to the specific aerial device.

5.2.9 Aerial **buckets/**platforms shall not have more occupants or load than allowed by the manufacturers' rating.

5.2.10 The operator shall stand firmly on the floor of the platform (aerial bucket) and shall not use railings, planks, ladders, or any other device in or on the bucket for achieving additional working height.

5.2.11 Climbing spurs (gaffs) shall not be worn while working from an aerial device.

5.2.12 A sheath or scabbard shall be utilized in the bucket to cover sharp-edged tools, such as chain saws and hand saws (unless of the folding type that covers the cutting teeth when closed), while stored for use.

5.2.13 During pruning/removal operations, a hand saw shall be taken by the aerial device operator while working aloft.

5.2.14 Before moving an aerial device for travel, the operator shall inspect the aerial device to ensure the boom(s) are cradled and secured, the tools are secured, and the outriggers are stowed or positioned for travel per manufacturer specifications.

5.2.15 When operating an aerial device, the operator shall look primarily in the direction the platform (aerial bucket) is traveling and be aware of the location of the booms, including the elbow/knuckle area, in relation to all other objects and hazards.

5.2.16 When transferring from the platform (aerial bucket) of an aerial device to a tree in order to complete an arboricultural operation, arborists shall remain **secured** to the aerial device until they are properly secured to the tree. At no time shall work be performed while an arborist is secured to both the aerial device and the tree.

5.2.17 Arborists shall remain properly secured at all times when transferring from the bucket of an inoperative aerial device to the platform (aerial bucket) of an operative aerial device to facilitate an emergency descent.

5.2.18 The lower controls of an aerial device shall not be used for continuous operation when the operator is in the platform (aerial bucket).

5.2.18.1 Lower controls shall not be operated unless permission has been obtained from the arborist in the platform, except in case of emergency.

5.2.19 Clearances from passing vehicles shall be maintained or traffic control shall be provided when booms or platforms (aerial buckets) are operated over roads in accordance with the Manual on Uniform Traffic Control Devices (MUTCD), Part 6, federal, state, or local, as applicable.

5.2.19.1 Clearances shall be maintained for outriggers and any other portion of the vehicle that may extend into or over the lanes of travel or that work over them.

5.2.20 Workers shall not perform arboricultural operations work, such as pruning or cutting of trees, from the top of vehicle bodies or cab protectors unless the worker is properly protected from the fall hazard.

5.2.21 Hydraulic/pneumatic tools shall be disconnected when they are being serviced or adjusted, except where manufacturers' procedures require otherwise.

5.2.22 To avoid flying particles or whipping hydraulic/pneumatic hoses, pressure shall be released before connections are broken, except where **quick-acting connectors** are used. Hydraulic/pneumatic hoses shall never be kinked in order to cut off pressure.

5.2.23 No part of the body shall be used to locate or stop hydraulic leaks.

5.2.24 Hoses affecting dielectric characteristics of equipment shall meet manufacturers' requirements.

5.2.25 The flash point of hydraulic fluid shall meet the requirements set by the manufacturer.

5.2.26 Booms, platforms (aerial buckets), or any other part of the aerial device shall not be allowed to make contact or violate minimum approach distances with energized electrical conductors, poles, or similar conductive objects.

5.2.26.1 Due to hazards of step and touch potential, if the distance between the aerial device and energized conductor(s) is unintentionally less than the required minimum approach distance (MAD), workers on the ground shall move away and remain clear of the aerial-device vehicle and attached equipment (e.g., chipper) until the required MAD is re-established.

5.2.27 Aerial devices equipped with an elevating structure that raises the turret and booms and changes the reach of the device's uninsulated portions shall be operated so that no portion of the aerial device and its elevating structure violate the minimum approach distance (MAD) from energized electrical lines as specified in this standard. A **spotter(s)** shall be used when the aerial lift is working close to MAD and potentially could violate MAD.

5.2.27.1 When the minimum approach distance (MAD) is likely to be violated, the spotter(s) shall warn the equipment operator and other ground personnel, if present, and direct ground personnel to keep clear of the vehicle and attachments until MAD is visually established and communicated.

5.2.28 Electric cables/cords used with electric saws, lights, or other conductive material shall not be run from the vehicle to the platform (aerial bucket) when arborists are working in proximity to energized electrical conductors.

5.2.29 (a) Platforms (aerial buckets) on insulated aerial devices shall have no through-cracks or holes below the lip of the platform.

(b) Insulating liners shall have no holes below the lip of the liner or vertical cracks greater than 6 inches (15.24 cm) long.

5.2.30 During aerial device operations, arborists and other workers shall maintain a minimum approach distance from energized electric conductors in accordance with the appropriate table of this standard as required by their level of training.

5.2.31 Arborists and other workers shall be instructed that insulated aerial platforms (aerial buckets) do not protect them from other electric paths to the ground, such as paths through trees or guy wires or from phase-to-phase contact. Either form of electric contact can be fatal.

5.2.32 Arborists using a **boom-supported elevating work platform** shall operate the platform within the limits of intended use as defined by the manufacturer in the operator's manual, ANSI/SIA A92.5, and applicable governmental regulations.

5.2.33 Only operators who have received instruction and training regarding the inspection, application, responsibilities, and operation shall operate a boom-supported elevating work platform. The operator shall be informed of the location of the manual and familiarized with the controls, safety devices, and operating characteristics of the work platform being operated.

5.2.34 Insulated boom-supported elevating work platforms shall meet the electric safety requirements of ANSI/SIA A92.2.

5.2.35 The operator shall assess the worksite hazards present that pertain to the use of a boom-supported elevating work platform on that worksite. The operator and other workers shall develop, communicate, and implement a work plan to mitigate the hazards identified on that worksite.

5.3 Brush Chippers

5.3.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.3.2 Access panels and guards for maintenance and adjustment, including the discharge chute and cutter housing, shall be closed and secured prior to starting the engine of brush chippers. These access panels shall not be opened or unsecured until the engine and all moving parts have come to a complete stop and the ignition key removed and pocketed (see Annex C.2, Control of Hazardous Energy).

5.3.3 Rotary drum or disc brush chippers not equipped with a mechanical infeed system shall be equipped with an infeed hopper not less than 85 inches (2.15 m) measured from the blades or knives to ground level over the center line of the hopper. Chippers with a mechanical infeed system shall also have a hopper not less than 85 inches (2.15 m) measured from the pinch point of the feeder wheels to ground level over the center line of the hopper. Side members of the infeed hopper shall have sufficient height so as to prevent workers from contacting the blades or knives during operations.

5.3.4 Rotary drum or disc brush chippers not equipped with a mechanical infeed system shall have a flexible anti-kickback device installed in the infeed hopper to reduce the risk of injury from flying chips and debris.

5.3.5 Chippers equipped with a mechanical infeed system shall have a quick-stop and reversing device on the infeed system. The activating mechanism for the quick-stop and reversing device shall be located across the top, along each side, and close to the feed end of the infeed hopper within easy reach of the worker.

5.3.6 Vision, hearing, and other appropriate personal protective equipment shall be worn when in proximity of an operating brush chipper, in accordance with Section 3.3, Personal Protective Equipment (PPE), and as defined by the **Personal Protective Equipment Hazard Certification.**

5.3.7 Arborists, mechanics, and other workers shall not reach beyond the plane of the infeed hopper when the cutter disc, rotary drum, or feed rollers are moving. If maintenance is needed, all moving parts shall come to a complete stop and keys shall be removed from the ignition and pocketed by the **authorized person** before proceeding. See Annex C.2, Control of Hazardous Energy.

5.3.8 For additional requirements, see Section 8.7, Brush Removal and Chipping.

5.4 Sprayers and Related Equipment

5.4.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.4.2 Working and walking surfaces of all sprayers and related equipment shall be covered with skid-resistant material.

5.4.3 Equipment on which the **applicator**/operator stands while the vehicle is in motion shall be equipped with guardrails around the working area. Guardrails shall be constructed in accordance with ANSI A1264.1.

5.4.4 All fittings and hoses shall be of sufficient strength to withstand or exceed the maximum pressure of the system. At no time should any part of the body be used to locate leaks or damaged sections of hose.

5.4.5 The operator shall be aware of the location and use of all safety shut-off valves.

5.4.6 All tanks shall have means to determine the level of liquid in the tanks without opening the tank lid.

5.4.7 The applicator/operator shall make a visual inspection of hoses, fittings, exposed plumbing, tanks, covers, and related equipment prior to its use each workday.

5.4.8 The applicator/operator shall not allow hoses or other parts of the equipment to create a tripping hazard for coworkers or the public.

5.4.9 The applicator/operator shall have a firm grip on the spray gun/excavation tool when pulling the trigger.

5.4.10 Entering enclosed tanks or spaces shall be prohibited unless performed through a confined-space entry plan in compliance with OSHA 1910.146 requirements, which include atmospheric quality testing, training, personal protective equipment, supervision, and emergency response procedures.

5.4.11 Related equipment

5.4.11.1 The applicator/operator shall be aware of underground utility locations when drilling holes in the ground for fertilizer or **pesticide** applications. All underground utility locations shall be determined by calling the 'Call before you Dig' national telephone number 811.

5.4.11.2 The equipment shall have splashguards, and the applicator shall wear eye protection when injecting liquid fertilizer or pesticides into the ground.

5.4.11.3 The applicator shall wear eye protection and follow label instructions when injecting liquids into trees.

5.5 Stump Grinders

5.5.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.5.2 Stump grinders shall be equipped with enclosures or guards that reduce the risk of injury during operation. Enclosures and guards shall be kept in place when the grinding wheels are rotating or cutting.

5.5.3 Arborists and other workers at the stump-grinding worksite shall wear eye, hearing, and other personal protective equipment in accordance with Section 3.3, Personal Protective Equipment (PPE).

5.5.4 The operator shall be aware of underground utility locations, per Subsection 3.4.2, prior to performing work. All work shall be in compliance with federal, state, and local underground facility protection laws (e.g., Dig Safe or One-call Underground Facility Locator programs).

5.5.5 The operator shall ensure that all other persons remain clear of the stump grinder while the cutting wheel is engaged, rotating, or grinding.

5.5.6 The operator shall ensure no secondary activities take place with the stump grinder, such as using the backfill blade, while the cutting wheel is engaged, rotating, or cutting.

5.5.7 Where equipment has no remote control capabilities, the operator shall stay at the controls during the operation of the stump grinder until the cutting wheel has stopped.

5.5.8 On equipment with remote controls, the operator shall remain a safe working distance as established by the employer or manufacturer, and clear of the materials being discharged and the cutting wheel while it is engaged, rotating, or grinding.

5.5.9 On equipment with tethered remote controls, the operator shall ensure that the operator and tether remain clear of the cutting wheel while it is engaged, rotating, or grinding.

5.5.10 Before leaving the machine unattended, the operator shall ensure that all moving parts have stopped and the key is removed and pocketed. When there is no keyed ignition system, the employer's procedures for securing the equipment shall be followed.

5.5.11 The operator shall ensure that the grinding wheel is disengaged and has stopped rotating prior to driving or moving the equipment.

5.5.12 Only employer-authorized personnel shall be permitted to perform maintenance. See Annex C.2, Control of Hazardous Energy.

5.5.13 When not in use, keys shall be removed and pocketed by the authorized person in charge. When there is no keyed ignition system, the employer's procedures for securing the equipment shall be followed.

5.6 Vehicles

5.6.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.6.2 Regulated vehicles (those in excess of 10,000 pounds gross vehicle weight rating, or gross combined vehicle weight rating) shall be operated in compliance with the Federal Motor Carrier Safety Regulations (FMCSR), state, and local laws.

5.6.3 A steel bulkhead or equivalent protective device shall be provided to protect workers from load shifts in vehicles carrying logs or other material.

5.6.4 Load securement procedures shall be followed to prevent accidental shifting or discharge of logs or other materials from the vehicle during transport.

5.6.5 Logs or other material shall not overhang the sides; obscure taillights, brake lights, or vision; or exceed height limits per state and local requirements for bridges, overpasses, utility lines, or other overhead hazards.

5.6.6 To avoid the hazard of spontaneous combustion, wood chips should not be left in vehicles for extended periods.

5.7 Cranes and Knucklebooms

5.7.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.7.2 Cranes shall be inspected in accordance with ASME B30.5 or ASME B30.22 (articulating boom) standards and manufacturers' guidelines. Rigging equipment shall be inspected before each use in accordance with OSHA 1910.184 and manufacturers' guidelines.

5.7.3 Operators of hoisting equipment shall be trained and shall maintain a 10-foot (3.05-m) minimum approach distance from unguarded, overhead energized conductors, or greater separation in accordance with Table 1 of this standard. A **spotter** shall be used when work is being performed that could encroach on minimum approach distances from energized conductors. The spotter shall be positioned to effectively gauge the clearance distance and give timely information to the **qualified crane operator**.

5.7.4 Only a qualified crane operator shall be used.

5.7.5 Cranes shall be equipped to comply with the design standards published in ASME B30.5 or ASME B30.22 (for articulating booms).

5.7.6 Hooks on overhaul ball assemblies, lower load blocks, or other attachment assemblies shall be of a type that can be closed and locked, eliminating the hook throat opening.

5.7.7 Crane operators shall remain at the controls while a load is **suspended**.

5.7.8 Tree sections shall be rigged to minimize load shifting. Controlled load lowering shall be used. **Shock-loading** shall be avoided, and free fall is prohibited.

5.7.9 The qualified crane operator and the arborist in charge shall meet prior to the work to review procedures to be followed. If the work involves a spotter/signal person and/or an additional qualified arborist being hoisted by the crane, these persons shall participate in the review as well. A job briefing shall be done before any work begins in accordance with Subsection 3.4.3.

5.7.10 Cranes shall be set up in accordance with manufacturers' specifications.

5.7.11 A qualified arborist may be hoisted into position utilizing a crane if he/she is **tied in** with an **arborist climbing line** and **arborist saddle** and secured to an anchor point on or above the crane hook or to the crane boom. The following procedures shall be followed when a qualified arborist is to be hoisted by a crane:

5.7.11.1 Only a qualified arborist shall authorize the use of a crane for hoisting a qualified arborist into position when he/she has determined that it is the safest and/or only feasible method to perform the work or to gain access to a tree.

5.7.11.2 The arborist climbing line shall be secured to the crane in such a way that it does not interfere with the function of any of the crane's components.

5.7.11.2.1 No part of the crane shall be allowed to compromise the climbing line or any component of the climbing system.

5.7.11.2.2 The qualified arborist shall use a second point of attachment on or above the crane hook or to the crane boom while being hoisted into position in the tree.

5.7.11.3 Continuous communication between the crane operator and the qualified arborist being hoisted shall be maintained, either directly or through a spotter/signal person, using two-way radio, vocal communication, or accepted hand signals (see Annex G, Hand Signal Chart for Crane Operations).

5.7.11.4 The qualified crane operator shall remain at the controls while the qualified arborist is attached to the crane.

5.7.11.5 When the qualified arborist is being hoisted, hoisting speed shall not exceed 100 feet/minute (0.5 m/sec). During hoisting operations, there shall be no sudden acceleration or deceleration of the moving load.

5.7.11.6 Controlled load lowering is required and free fall of the load line hoist is prohibited if an employee is being hoisted.

5.7.11.7 The crane carrier shall not travel at any time while a qualified arborist is attached.

5.7.11.8 An accurate estimation of the **load radius** to be used during lifting shall be made before a qualified arborist is hoisted.

5.7.11.9 The qualified arborist shall be detached from the crane any time a load is suspended.

EXCEPTION

When it has been determined that all reasonably possible alternate methods are inaccessible and attachment to the subject tree would create a greater safety risk due to its hazardous condition, the qualified crane operator and the qualified arborist shall allow the qualified arborist to remain attached to the crane while a load is suspended. Possible alternate methods include, but are not limited to:

(a) the qualified arborist securing to the tree and detaching from the crane before it comes under load;

(b) using a second crane;

(c) using an aerial lift device; or

(d) using an adjacent tree.

5.7.11.9.1 When the qualified arborist is attached to the crane with a suspended load, the total weight shall not exceed 50 percent of the load capacity for the radius and configuration of the crane.

5.7.11.9.2 The qualified arborist shall descend to the ground as soon as he/she has determined that the piece is detached from the tree and that it is safe to do so.

5.7.12 The qualified arborist shall estimate the weight of the tree section to be suspended prior to cutting the section. The load weight estimate shall be communicated to the crane operator. After the pick is complete, the crane operator should verify, compare, and communicate the estimated weight to the qualified arborist. A green log weight chart (as shown in Annex E, Weight of Green Logs) shall be available to the crew. The suspended load should not exceed 75 percent of the load chart capacity of the crane.

5.7.13 Radio communication between the qualified arborist and qualified crane operator shall be used during **blind picks**. Radio communication shall be hands-free.

5.8 Specialized Units

5.8.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.8.2 Off-road and tracked vehicles shall be operated according to the operating environment and the manufacturers' instructions and guidelines.

5.8.3 Towing equipment for **brush hogs** and similar implements should be equipped with a **deadman control**. When deadman controls are not available, the worker shall disengage the power source to the rotary or cutter head before dismounting.

5.9 Equipment-Mounted Winches

5.9.1 The items contained in Section 5.1, Vehicles and Mobile Equipment, shall always be included in the review of this section.

5.9.2 Each day before being used, the winch line and all fastenings and attachments shall be inspected for damage or defects by a qualified person. Additional inspections shall be performed during winch line use, where service conditions warrant. Damaged or defective winch lines shall be immediately removed from service.

5.9.3 Winch line hooks and attachment points shall be inspected for damage. Damaged hooks or attachment assemblies shall be taken out of service.

5.9.4 All mounting bolts and hardware shall be inspected for loose or missing components. The winch shall not be used until complete repairs are made to damaged or missing bolts and hardware.

5.9.5 Operators shall be aware of the hazards of load or winch line breakage and ensure that all personnel remain clear of the recoil area in the event of load or winch line breakage.

5.9.6 All winch operators shall be properly trained and be aware of the inherent dangers associated with winch operations.

5.9.7 Operators shall be aware of the winch line at all times during extension and ensure that it does not become a hazard to personnel or machinery.

5.9.8 Winch systems and winch lines shall be used only as intended and instructed by the manufacturer.

5.9.9 A winch line should not be wrapped around a load. During winching operations of loads that do not have a manufactured attachment point, the load should be secured using a sling.

5.9.10 The winch shall never be used with personnel, including the operator, within the span of the winch line and the winch.

5.9.11 Pinch point hazards develop during winching operations; therefore, all operators involved in the winching operation shall constantly be aware of such hazards and stand clear of these areas.

5.9.12 All loads shall be pulled in such a manner as to avoid angles that may result in tipping, cause the vehicle to become unstable, or result in unintended movement of the vehicle.

5.9.13 Pulling loads from the side requires special equipment and techniques. Therefore, loads shall be pulled in line with the winch unless the winch is properly equipped with a fair lead and the operator is trained to pull loads at an angle.

5.9.14 The operator shall ensure that the vehicle supporting the winch is secured to avoid unintended movement.

5.9.15 The operator shall ensure that all rigging points comply with Section 8.5, Rigging.

5.9.16 An effective means of communication shall be established and used with all workers involved in the winching operations (see Subsection 8.5.11).

5.9.17 Winch lines shall be **compatible** with the winch design and shall meet manufacturers' specifications.

5.9.18 When using a winch in chipper operations, the operator shall ensure that the winch line is properly stored before initiating chipper operations.

EXCEPTION

A winch line may be used to assist with positioning material onto the feed table and infeed hopper. Once the material has been positioned, the winch line must be properly stored before continuing chipping operations.

6 PORTABLE POWER HAND TOOLS

6.1 General

6.1.1 All applicable requirements in Section 3, General Safety Requirements, shall apply to this section.

6.1.2 The purpose of this section is to provide guidelines for arborists and other workers pertaining to the safe use and care of portable power hand tools.

6.1.3 The employer should follow the manufacturers' operating, maintenance, and safety instructions, unless the employer demonstrates that a greater hazard is posed by following the manufacturers' instructions.

6.1.4 Before starting or operating portable power hand tools, the operators shall communicate with and ensure that all other workers are clear of the equipment, the swing arc of the cutting attachment, and the immediate worksite.

6.1.5 Communication shall be established between the arborists working aloft, either in a tree or from an aerial device, and arborists and other workers on the ground, before starting or otherwise using any portable power hand tools. The command "stand clear" from aloft and the response "clear" from the ground are terms that may be used for this purpose. Pre-arranged, two-way hand signals may also be used. Workers shall stay out of the drop zone until it has been communicated by the qualified arborist, **qualified arborist trainee**, or worker aloft that it is safe to enter.

6.1.6 When a chain saw or power hand tool is carried aloft and is not in use, it shall be secured against falling.

6.2 Portable Electric Power Tools

6.2.1 The items contained in Section 6.1, General, shall always be included in the review of this section.

6.2.2 Corded electric power tools shall not be used in trees or aerial devices near energized electrical conductors where there is a possibility of power tools or supply cords contacting the conductor.

6.2.3 All corded portable electric power tools shall be:

(a) equipped with three-wire cords having the ground wire permanently connected to the tool frame and a means for grounding the other end; or

(b) double insulated and permanently labeled as "double insulated"; or

(c) connected to power supplies by means of an isolating transformer or other isolated power supply.

6.2.4 Extension cords shall be maintained in safe condition. Exposed metal sockets shall not be used.

6.2.5 Arborists and other workers shall prevent cords from becoming entangled, damaged, or cut by blades and bits and shall avoid laying extension cords in water.

6.3 Chain Saws

6.3.1 The items contained in Section 6.1, General, shall always be included in the review of this section.

6.3.2 Chain saws shall not be operated unless the manufacturers' safety devices are in proper working order. Chain saw safety devices shall not be removed or modified.

6.3.3 A stable body position shall be maintained when starting a chain saw.

6.3.4 **Drop-starting** a chain saw is prohibited. A chain saw shall be started with the chain brake engaged and the operator holding the saw firmly in a manner that minimizes movement of the saw when pulling the starter handle.

6.3.5 A chain saw shall be operated with two hands at all times, one hand on each handle with thumbs wrapped around the handles.

6.3.5.1 The operator shall operate the chain saw with the left hand and thumb gripped firmly around the forward handle and the right hand and thumb gripped firmly around the rear handle, unless it is not practicable, and the employer demonstrates that a greater hazard is posed by operating the chain saw that way in that particular situation.

6.3.6 Arborists shall be tied in and use a second means of being **secured** [e.g., **lanyard (work-positioning lanyard)** or second climbing line] when operating a chain saw in a tree. Using two work-positioning lanyards or both ends of a two-in-one work-positioning lanyard shall not be considered acceptable as two means of being secured when using a chain saw in a tree.

EXCEPTION

When the employer demonstrates that a greater hazard is posed by using a second means of being secured while operating a chain saw in that particular situation.

6.3.7 The chain brake shall be engaged or the engine shut off before setting a chain saw down.

6.3.8 When a chain saw is being carried more than two steps, the chain brake shall be engaged or the engine shut off. The chain saw shall be carried in a manner that will prevent operator contact with the cutting chain and the muffler.

6.3.9 The chain saw operator shall be certain of a stable body position before starting to cut. The chain saw shall not be used in a position or at a distance that could cause the operator to become off-balance, have insecure footing, or relinquish a firm grip on the saw. A chain saw shall not be used above shoulder height unless the employer demonstrates that a greater hazard is posed by operating the chain saw that way in that particular situation.

6.4 Powered Pole Tools and Backpack Power Units

6.4.1 The items contained in Section 6.1, General, shall always be included in the review of this section.

6.4.2 Powered pole tools with poles made of metal or other conductive material shall not be used in operations where electrical hazards exist. See Subsection 8.3.5 of this standard.

7 HAND TOOLS AND LADDERS

7.1 General

7.1.1 All applicable requirements in Section 3, General Safety Requirements, shall apply to this section.

7.1.2 Correct hand tools and equipment shall be selected for the job.

7.1.3 Hand tools and equipment that have been made unsafe by damage or defect, including tools with loose or cracked heads or cracked, splintered, or weakened handles, shall not be used.

7.1.4 Workers shall maintain a safe working distance from other workers when using hand tools and equipment.

7.1.5 When climbing into a tree, arborists shall not carry hand tools and equipment in their hands unless the tools are used to assist them in climbing. Tools other than ropes or throwlines shall not be thrown into a tree or between workers aloft.

7.1.6 Arborist climbing lines or **handlines (line, handline)** may be used for raising and lowering hand tools and equipment. Arborists should raise or lower hand tools and equipment in a manner such that the cutting edge will not contact the arborist climbing line or handline.

7.1.7 Hand tools and equipment shall be properly stored or placed in plain sight out of the immediate worksite when not in use.

7.2 Cant Hooks, Cant Dogs, Peaveys, and Tongs

7.2.1 The items contained in Section 7.1, General, shall always be included in the review of this section.

7.2.2 **Cant hooks**, cant dogs, peaveys, and tongs should be firmly set before applying force.

7.2.3 Points of hooks shall be at least 2 inches (5 cm) long and kept sharp.

7.2.4 Arborists and other workers shall always stand uphill from rolling logs, and all workers shall be warned and in the clear before logs are moved.

7.3 Wedges, Chisels, and Gouges

7.3.1 The items contained in Section 7.1, General, shall always be included in the review of this section.

7.3.2 **Wedges**, chisels, and gouges shall be inspected for cracks and flaws before use. Tools with damaged heads shall not be used.

7.3.3 Wedges and chisels shall be properly pointed and tempered.

7.3.4 Eye protection shall be used during impact operations.

7.3.5 Only wood, plastic, or soft-metal wedges shall be used while operating chain saws.

7.3.6 Wood-handled chisels should be protected with a ferrule on the striking end.

7.3.7 Wood, rubber, or high-impact plastic **mauls**, sledges, or hammers should be used when striking wood-handled chisels or gouges.

7.4 Chopping Tools

7.4.1 The items contained in Section 7.1, General, shall always be included in the review of this section.

7.4.2 **Chopping tools** should not be used while working aloft.

7.4.3 Chopping tools shall not be used as wedges or used to drive metal wedges.

7.4.4 Chopping tools shall be swung away from the feet, legs, and body, using the minimum force practical for function and control.

7.4.5 When swinging tools such as grub hoes, mattocks, and axes, a secure grip, firm footing, and clearance of workers and overhead hazards shall be maintained.

7.5 Ladders

7.5.1 The items contained in Section 7.1, General, shall always be included in the review of this section.

7.5.2 Ladders made of metal or other conductive material shall not be used where electrical hazards exist. Only wooden ladders (constructed in accordance with ANSI A14.1) or nonconductive ladders made of synthetic material equal to or exceeding the strength of wooden ladders shall be used.

7.5.3 Metal ladders used where no electrical hazard exists shall conform to ANSI A14.2.

7.5.4 All ladders shall be inspected before use and removed from service if found defective.

7.5.5 Cleats, metal points, skid-resistant feet, lashing, or other effective means of securing the ladder shall be used when there is danger of slipping.

7.5.6 Ladders shall not be used as bridges or inclined planes to load or handle logs or other material.

7.5.7 Ladders shall be supported while in storage to prevent sagging. Except when on mobile equipment, ladders should be stored under suitable cover, protected from the weather, and kept in a dry location away from excessive heat.

7.5.8 The third, or hinged, leg of a **tripod/orchard ladder** shall be braced or fastened when on hard or slick surfaces.

7.5.9 All ladders shall be used in accordance with the manufacturers' recommendations and shall not be altered in a way that contradicts those recommendations.

8 TREE CLIMBING

8.1 Climbing Procedures

8.1.1 All applicable requirements in Section 3, General Safety Requirements, shall apply to this section.

8.1.2 A second arborist, an arborist trainee, or other worker trained in emergency procedures shall be within visual or voice communication during arboricultural operations above 12 feet (3.65 m) that are not subject to the requirements of Subsection 4.3.9.

8.1.3 Arborists shall inspect climbing lines, **worklines (line, workline)**, work-positioning lanyards, and other climbing equipment for damage, cuts, abrasion, and/or deterioration before each use and shall remove them from service, per manufacturers' guidelines if applicable, if signs of excessive wear or damage are found. Climbing lines or worklines that are removed from service may be used for other noncritical purposes if deemed suitable for such use by a qualified person.

8.1.4 While working aloft, the climber shall have available a climbing line and at least one other means of being secured on his/her person at all times (e.g., an arborist climbing line and a work-positioning lanyard). Two means of being secured shall be used when the climber determines that it is advantageous.

8.1.5 The climber shall have a hand saw available while working aloft. Hand saws aloft shall either have a scabbard or be of the folding type that covers the cutting teeth when closed.

8.1.6 The arborist shall be secured at all times while ascending the tree, including when using climbing spurs/gaffs. The arborist shall be tied in once the work begins and shall remain tied in until the work is completed and he/she has returned to the ground. The arborist shall be secured when repositioning the climbing line. When repositioning, the arborist shall preload the new tie-in point with his/her full weight before releasing the current means of being secured.

8.1.7 While ascending a ladder to gain access to a tree, the arborist shall not work from or leave the ladder until he/she is tied in or secured.

8.1.8 Hands and feet should be placed on separate limbs, if possible, and three points of contact should be maintained with the tree while climbing.

8.1.9 A **false crotch** and/or false-crotch redirect may be used at the discretion of the arborist in lieu of a natural **crotch**.

8.1.10 The climber shall select a tie-in-point/primary suspension point that prevents lateral movement of the climbing line.

8.1.11 When installing the climbing line or false crotch from the ground, it should be positioned in a suitable location along the main stem/leader/lateral limb. The climber shall visually inspect the anchor point for condition from the ground and, if suitable, shall subject it to a load approximately twice the weight of the climber before climbing commences.

8.1.12 The tie-in point should be positioned so that the arborist will not be subjected to an uncontrolled pendulum swing.

8.1.13 When an arborist is working at heights greater than one-half the length of the arborist climbing line, a stopper knot shall be tied in the end of the arborist climbing line to prevent pulling the line through the climbing hitch.

8.1.14 Arborists working from a stem or **spar** without a suitable natural crotch shall select tie-in points or a tie-in method that positively prevents the climbing line from sliding down or up or off the stem during climbing operations. Placing a climbing line around a stem in an area without a lateral limb is not acceptable unless the climbing line is cinched or choked around the stem or runs through a double wrapped or adjustable false crotch, which is secured/cinched around the stem. The tie-in point selected shall be able to withstand the forces being applied during the pruning/removal operation.

8.1.15 If a climbing line is damaged in the course of operations, the arborist shall secure himself/herself with a work-positioning lanyard and immediately replace the damaged line.

8.1.16 The ground crew shall keep the climbing line free of debris and obstructions, protect it from damage, and report any damage to the arborist.

8.1.17 The arborist shall check his/her climbing line beneath the climbing hitch for damage while descending.

8.2 Ropes and Arborist Equipment

8.2.1 Climbing lines used in a **split-tail** system and split-tails shall be terminated with an eye splice or a knot that interfaces appropriately with the connecting link. When using a carabiner without a

captive eye, the termination selected shall maintain loading along the major axis. The connection between carabiners and terminated rope ends shall be compatible to limit the possibility of accidental disconnection or minor axis loading of carabiners.

8.2.2 The arborist shall assure that arborist saddles and climbing gaffs/spurs comply with an appropriate governing standard, and shall be marked accordingly on the product, when new (e.g., arborist saddles marked ASTM F887 if manufactured after 1/1/2018).

8.2.3 Arborist saddles and work-positioning lanyards shall not be altered in a manner that would compromise the integrity of the equipment.

8.2.4 Arborist climbing lines used for **moving rope systems** shall have a minimum diameter of 1/2 inch (12.7 mm) and be constructed from a synthetic fiber, with a minimum breaking strength of 5,400 pounds (24.02 **kilonewtons** [kN]) without terminations when new. Maximum working elongation shall not exceed 7 percent at a load of 540 pounds (2.402 kN). Arborist climbing lines shall be identified by the manufacturer as suitable for tree climbing.

EXCEPTION

In arboricultural operations not subject to regulations that supersede Z133, a line of not less than 7/16 inch (11 mm) diameter may be used, provided the employer can demonstrate it does not create a safety hazard for the arborist and the arborist has been instructed in its use. The line selected shall meet or exceed the standards for arborist climbing lines and shall be identified by the manufacturer as suitable for tree climbing.

8.2.5 Arborist climbing lines used for stationary rope systems shall conform to the diameter, construction, strength, and elongation standards of Subsection 8.2.4 and shall be compatible with the components used in the **stationary rope system**.

8.2.6 **Prusik loops**, split-tails, doubled-hitch cords, and work-positioning lanyards used in a climbing system shall meet the minimum breaking strength of 5,400 pounds.

8.2.6.1 Hitch cords, Prusik loops, and split-tails shall be manufactured from material(s) suitably resistant to the abrasion and temperatures experienced during work and rescue scenarios.

8.2.7 Snap hooks (rope snaps) used as part of a climber's work-positioning (suspension) system shall be self-closing and self-locking, with a minimum tensile strength of 5,000 pounds (22.24 kN).

8.2.8 Carabiners used as part of a climber's work-positioning (suspension) system shall be self-closing and self-double locking and shall have a gate-locking mechanism that requires at least two consecutive, deliberate actions to unlock. A carabiner shall be capable of withstanding a 5,000 pound (22.24 kN) load along its major axis with the gate closed without breaking or distortion sufficient to release the gate.

8.2.9 Carabiners and snap hooks used as part of a climber's fall protection (work-positioning/suspension/fall-arrest system) shall not be linked together unless designed to do so and accepted by the manufacturer.

8.2.10 Load-rated screw links used as part of a climber's work-positioning (suspension) system shall have a tensile strength of 5,000 pounds (22.24 kN) and shall be securely tightened to ensure they will not unintentionally open during use.

8.2.11 Splicing shall be done in accordance with manufacturers' specifications.

8.2.12 Equipment used to secure an arborist in a tree or to an aerial device shall not be used for anything other than its intended purpose.

EXCEPTION

An arborist's climbing line may be used to raise and lower lightweight tools and equipment such as chain saws, hand tools, and additional lines.

8.2.13 Rope ends shall be finished in a manner to prevent raveling.

8.2.14 Ropes and climbing equipment shall be stored and transported in such a manner to prevent damage through contact with sharp tools, cutting edges, gas, oil, or chemicals.

8.2.15 Arborist climbing lines shall never be left in trees unattended.

8.2.16 Climbing spurs shall have gaffs of the type and length suitable for the tree being climbed. Manufacturers' recommendations for inspection, maintenance, sharpening, and replacing worn gaffs shall be followed.

8.2.17 The non-working end of any work-positioning lanyard shall have a fixed termination such as a fixed stopper knot, eye splice, snap, carabiner, or other hardware that does not permit the non-working end of the lanyard to advance through the friction device, or it shall be securely connected to a rated connection point on the climbing saddle.

8.3 Pruning and Trimming

8.3.1 Pruning should be conducted in accordance with the ANSI A300 (Part 1) standard.

8.3.2 The arborist in charge shall establish a safe work plan to manage the drop zone. Communications among arborists aloft and other workers on the ground shall be established before cutting and dropping limbs. The command "stand clear" from aloft and the response "all clear" from the ground are terms that may be used for this purpose. Pre-arranged, two-way hand signals may also be used. Arborists and other workers returning to the drop zone shall be acknowledged by arborists aloft.

8.3.3 Pole pruners and pole saws, when hung, shall be securely positioned to prevent dislodgment. Pole pruners or pole saws shall not be hung on electrical conductors or left in a tree unattended.

Pole saws and pole pruners shall be hung so that sharp edges are away from the arborist and shall be removed when the arborist leaves the tree.

8.3.4 Scabbards or sheaths shall be used to carry hand saws. Folding hand saws, when not in use, shall be stowed in a manner that protects the worker and others from the cutting edge.

8.3.5 Pole tools used in proximity to energized conductors shall be constructed with fiberglass-reinforced plastic (FRP) or wooden poles meeting the requirements of OSHA 1910.269(r)(1)(iv).

8.3.6 Limbs that cannot be safely controlled by hand or free-dropped shall have a separate rigging line attached to them to help control their fall. Rigging practices shall conform to the requirements in Section 8.5, Rigging, of this standard.

8.3.7 Dry conditions and dead palm fronds present an extreme fire hazard. When dry conditions exist, arborists and other workers shall not smoke while working in or near dead palm fronds. All chain saws used under such conditions shall have mufflers and spark arresters in **good working condition.**

8.3.8 Palm frond skirts shall be removed from the top down. Arborists performing this work while climbing shall be supported by an arborist climbing system, and when possible, positioned above the skirt. Arborists should not remove palm skirts by positioning themselves below the frond skirt or between the palm skirt and the trunk of the tree.

8.3.9 Cut branches, tools, and equipment shall be removed from trees upon completion of work.

8.4 Cabling

8.4.1 Cabling should be conducted in accordance with the ANSI A300 (Part 3) standard.

8.4.2 Arborists and other workers on the ground shall not stand in the drop zone when a cabling system is being installed.

8.4.3 Tools used for cabling shall be carried in a bag, placed on a belt designed to hold such tools, or securely attached to a **lanyard (tool lanyard)** to prevent the tools from falling.

8.4.4 When installing or replacing a support system, the load shall be released onto the new support system in a slow and controlled manner to help prevent sudden or dynamic loading.

8.4.5 When a previously installed support system is to be removed or replaced, it shall not be removed until a new support system is installed to take the weight off of the previously installed system, or until a temporary support system has been installed to slacken the previously installed system.

8.5 Rigging

8.5.1 Arborists performing rigging operations shall inspect trees for their integrity to determine whether the trees have any visible defect that could affect the operation. If it is determined that the tree poses a risk of failure due to the forces and strains that will be created by the design of the rigging operation, an alternate plan shall be used.

8.5.2 Rigging points shall be assessed for their structural integrity by a qualified arborist. The work plan and the tree shall be considered relative to the forces being applied to any part of the tree, including branch attachments and anchoring roots, before a rigging point is chosen and established.

8.5.3 Arborists performing rigging operations shall be trained to estimate the potential forces at any point in the rigging system being used. The system components shall comply with **working-load limits** relative to the operation and the maximum potential forces.

8.5.4 Careful consideration shall be given to the potential for additional forces resulting from the influences of rigging design, rope angles, and the number of lines and/or line parts that will act on any rigging or anchor point.

8.5.5 A qualified arborist shall ensure that load ratings shown on the rigging equipment or provided by the manufacturer for all ropes, connecting links, and rigging equipment are observed in all rigging operations. Rigging equipment shall be chosen for the specific task based on working-load limits and design specifications. If a carabiner is used in a rigging system, loading of the gate and/or the minor axis of the carabiner shall be prevented.

8.5.6 The number of connecting links used for connecting components of a rigging system shall be minimized when possible. Arborists shall ensure that shackles, screw links, and other connecting links interface properly and are in compliance with manufacturers' recommendations.

8.5.7 All equipment used for rigging operations shall be in good working condition. Rigging equipment and its connecting links shall be inspected immediately before use and removed from service if found to be defective, damaged, or overloaded.

8.5.8 When the potential exists for rigging equipment to be confused with climbing equipment, the equipment shall be clearly marked to indicate its different purposes.

8.5.9 When establishing a rigging point horizontally distant from the parent limb or main tree stem, the arborist should consider the need to provide additional support to help disperse the force of the proposed rigged load.

Options may include:

(a) Use of a **backstay** to support the load-bearing rigging point by placing an appropriately rated rope from the limb used as the load-bearing rigging point back to a higher point on the main trunk of the tree or other higher and suitable limb; or

(b) Installation of an additional and separate rigging system that utilizes supporting members, other than those already in use by the primary lowering point, in an effort to have both rigging systems share the load force.

8.5.10 Workers aloft (either climbing the tree or from an aerial device) shall establish a communication system with arborists and other workers on the ground.

8.5.11 A method of verbal, audible, or visual communication shall be discussed and established during the job briefing prior to the start of removal or rigging operations. The verbal, audible, or visual communication system shall use an established command-and-response system (see example) or pre-arranged, two-way hand signals. The communication method shall be clearly understood and used during all rigging operations.

Example (but not limited to):

Command:

- Stand clear!

Response:

- Clear!
- Underneath!

  or
- Stop!

8.5.12 A drop zone shall be established prior to the start of rigging operations. Workers shall stay out of the drop zone until it has been communicated by a qualified arborist, a qualified arborist trainee, or the worker aloft directly involved in the rigging operation that it is safe to enter.

8.5.13 Only qualified arborists or qualified arborist trainees directly involved in the operation shall be permitted in the drop zone when a load is being suspended by the rigging system.

8.5.14 **Taglines (line, tagline)** or other means may be used to help control and handle suspended loads.

8.5.15 Ground workers involved in handling rigging lines shall not be underneath moving or suspended loads and should be out of the drop zone when practical.

8.5.16 Workers aloft shall position themselves above or to the side of the piece being rigged and out of the path of movement of the piece and attached rigging when the piece has been cut. Climbers shall have a retreat/escape plan prepared.

8.5.17 Climbers and their climbing systems shall not make contact with moving or swinging parts of the rigging system when making a release cut or when the load is moving. Rigging systems shall not compromise any part of the climbing system.

8.5.18 Steps shall be taken to prevent spars from splitting or tearing during the rigging operation, and climbers shall take steps to avoid trapping, pinning, or entangling themselves in the system should the tree split or the rigging fail. Load binders are one possible means of preventing splitting.

8.5.19 A hand saw shall be with a worker aloft to make or finish cuts.

8.6 Tree Removal

8.6.1 Before beginning any tree removal operation, the chain saw operator and/or **crew leader** shall carefully consider relevant factors pertaining to the tree and site and shall take appropriate actions to ensure a safe removal operation. Factors to include may be, but are not limited to, tree decay, tree lean, and wind (see Annex C.3, Manual Tree Felling Procedure, for a more inclusive list).

8.6.2 The crew leader shall assess the number of workers necessary for the tree removal operations, develop a tree removal work plan, and communicate the work plan and job task assignments in a job briefing with the crew prior to beginning the tree removal work. In addition, a method of verbal, audible, or visual communication as set forth in Subsection 8.5.11 shall be discussed and established during the job briefing prior to the start of tree removal operations.

8.6.3 A drop zone shall be established prior to the start of piecing-down tree removal operations. Workers shall stay out of the drop zone until it has been communicated by a qualified arborist, a qualified arborist trainee, or the worker aloft directly involved in the piecing-down tree removal operation that it is safe to enter.

8.6.4 In **manual tree felling** operations, non-involved workers shall be positioned at a distance from the tree at least two (2.0) times the height of the tree or trunk being removed until the chain saw operator and/or crew leader communicates that it is safe to approach more closely. Involved workers other than the chain saw operator, including but not limited to those who handle ropes/taglines, come-alongs/winches, etc., shall be positioned at a distance from the tree at least one-and-one-half (1.5) times the height of the tree or trunk being removed until the chain saw operator and/or crew leader communicates that it is safe to approach more closely.

8.6.5 A planned retreat/escape path for all workers involved in the tree removal operation shall be prepared before piecing down tree parts or manual tree felling.

8.6.5.1 During manual tree felling, the preferred retreat/escape path for the chain saw operator is 45 degrees on either side of a line drawn opposite the intended direction of the fall.

8.6.5.2 To the extent practical, the retreat/escape path shall be cleared of obstructions and objects that would hinder retreat.

8.6.5.3 The chain saw operator shall use this path for egress once the felling cuts have been completed or the tree begins to fall.

8.6.5.4 Other involved workers shall have and use retreat/escape paths that do not hinder other retreating workers or expose any involved workers to increased hazard.

8.6.6 When it is necessary to use rigging to shorten or remove branches or to block down pieces of the tree, the qualified arborist shall consider whether the tree can withstand the strain of the lowering procedures. If the qualified arborist determines that the tree cannot withstand the strain of the lowering procedures, other means of removing the tree shall be implemented.

8.6.7 A rope should be attached to all trees and stems greater than 5 inches (12.7 cm) in **diameter at breast height (dbh)** being felled to provide stabilization and/or directional pull where assisted directional felling is required.

8.6.8 When there is a risk of damage to property from a tree piece or tree falling in an unintended direction, rope(s), block and tackle, come-alongs/winches, wire cable (except where an electrical hazard exists), or other appropriate devices shall be used to control the direction of fall.

8.6.8.1 Loaders, skid steers, or other heavy equipment shall not be used to push over trees that are being manually felled while any worker is within 1-1/2 times the height of the tree being felled. The heavy equipment being utilized shall be of the appropriate size for the task and shall offer appropriate protection for the operator.

8.6.9 Wedges should be used when determined to be necessary to prevent binding of the guide bar or chain when felling trees or stems. Wedges may be used as an aid in directional tree felling.

8.6.10 All equipment used for tree removal operations shall be in good working condition. Tree removal equipment and its connecting links shall be inspected immediately before use and removed from service if found to be defective, damaged, or overloaded.

8.6.11 Tree limbs shall be removed to a height and width sufficient to allow the tree parts or tree to fall clear of hazards, such as utility wires and/or other objects in the vicinity.

8.6.12 During manual tree felling operations, notches shall be used on all trees and trunks greater than 5 inches (12.7 cm) dbh.

8.6.13 When manually felling trees, notches and **back cuts** shall be made at a height that enables the chain saw operator to safely begin the cut, control the tree or trunk, and have freedom of movement toward a retreat/escape path.

8.6.13.1 The two cuts that form the notch shall meet at a point called the **apex** and shall not cross that point or go beyond the point where they meet.

8.6.13.2 The notch cut used shall be an **open-face notch**, a **conventional notch**, or a **Humboldt notch**.

8.6.13.3 Notches shall be 45 degrees or greater and wide enough to guide the fall of the tree or trunk.

8.6.13.4 Notch depth should not exceed one-third the diameter of the tree.

8.6.13.5 Saw cuts made to form the notch and back cut shall leave suitable **hinge** wood to adequately control the fall of the tree.

8.6.13.6 With an open-face notch (greater than 70 degrees), the back cut should be at the same level as the apex of the notch. With a conventional notch or Humboldt notch, the back cut shall be 1 to 2 inches (2.5 to 5 cm) above the apex of the notch to provide an adequate platform to reduce kickback potential of the tree or trunk.

8.6.14 The hazard of **barber chair** should be considered when cutting trees under tension. Steps to prevent the sudden splitting of trunk wood should be taken. Preventive steps may include, but are not limited to, various back cut methods; wrapping a ratchet strap, rope, or chain around the tree above the notch and back cut area; or relieving the tension in or on the tree by slackening pull ropes or removing upper parts of the tree prior to felling.

8.6.15 Before making the back cut, there shall be a command such as "stand clear" from the arborist operating the chain saw and a response such as "clear" from the workers supporting the removal operation. Pre-arranged, two-way hand signals or two-way audible devices such as air horn or whistle signals may also be used. Only designated persons shall give such signals.

8.6.16 During manual tree felling operations, involved workers shall keep visual contact with the tree or trunk until it is on the ground.

EXCEPTION

When the tree or trunk begins to fall, the worker at the base of the tree shall immediately move a safe distance away from the tree or trunk using the retreat/escape path.

8.6.17 Workers shall not approach closer than manufacturers' or employers' specified distances to mechanical operations, such as a rotary or flail mower, or boom-mounted saws, until all cutting has halted and the equipment operator has acknowledged that it is safe to do so.

8.7 Brush Removal and Chipping

8.7.1 Prior to the start of chipping operations, vehicular and pedestrian traffic control around the work zone shall be established in accordance with applicable local, state, or federal requirements. See Section 3.5, Traffic Control.

8.7.2 Brush and logs shall be placed in such a way that does not create hazards in the worksite.

8.7.3 Loose-fitting items that could create an entanglement hazard (e.g., clothing, jewelry), aerial lift or climbing equipment, improperly worn PPE, or gauntlet-type gloves, shall not be worn while operating chippers.

8.7.4 Personal protective equipment shall be worn when on the worksite of chipping operations in accordance with Section 3.3, Personal Protective Equipment (PPE), of this standard.

8.7.5 During chipping operations, workers shall ensure that all throwlines and climbing and rigging lines are clear of the chipping area.

8.7.6 Only persons trained in safe chipper operation may operate chippers. Training shall include, but is not limited to, inspection, starting, stopping, feeding, and shutdown. Training shall be provided for each type of chipper being used.

8.7.7 Only persons authorized by the employer shall perform maintenance (see Annex C, General Safety Procedures That Apply to All Tree Work).

8.7.8 During chipping operations, hands, feet, or other parts of the body shall not pass beyond the plane of the infeed hopper. Leaning into or pushing material into infeed hoppers with feet is prohibited.

8.7.9 When hand-feeding a chipper, brush and logs shall be fed into chippers from the side of the feed table center line. Brush and logs should be fed butt or cut end first, and the operator shall immediately turn and step away from the feed table when the brush is taken into the rotor or feed rollers.

8.7.10 When hand-feeding a chipper during roadside operations, the operator should work from the curb or shoulder side whenever practical to prevent himself/herself from stepping into traffic or being pushed into traffic by the material that is being fed into the chipper.

8.7.11 Brush chipper discharge chutes shall not be removed nor shall the cutter housing cover be opened or raised while any part of the chipper is turning or moving. Chippers shall not be used unless a discharge chute of sufficient length or design is provided that prevents personal contact with the blades (see Annex C, General Safety Procedures That Apply to All Tree Work).

8.7.12 Material, such as stones, nails, or sweepings shall not be fed into chippers.

8.7.13 Limbs, logs, brush, and other woody material should be cut/prepared prior to feeding into the chipper.

8.7.14 Small vegetation shall be fed into chippers with longer branches or pushed with a longer branch, push paddle, or suitable non-metallic tool.

8.7.15 During chipping operations, operators shall be aware of potential pinch hazards between the machine and materials being chipped, and within the material itself.

8.7.16 When using a winch in chipper operations, the winch line and/or winch line hook shall never pass beyond the plane of the infeed hopper. Once the material is controlled by the feeder wheels, the feeding process shall be stopped and the winch line and/or hook shall be properly stowed before proceeding.

8.7.17 Should the chipper become clogged, procedures for the Control of Hazardous Energy (Annex C.2) shall be referenced and followed as appropriate.

8.7.18 Due to the hazards of step and touch potential, if the distance between the aerial device and energized conductor(s) is unintentionally less than the required minimum approach distance (MAD), workers on the ground shall move away and remain clear of the aerial-device vehicle and attached equipment (e.g., chipper) until the required MAD is reestablished.

8.7.19 Refer to Section 5.3, Brush Chippers, for additional information.

8.7.20 Specialized material handling equipment, such as but not limited to skid-steers or mini-loaders (whether wheeled or tracked), when used in chipping operations, shall not create a hazard for other workers.

8.8 Limbing and Bucking

8.8.1 Work plans for **limbing** and **bucking** operations shall be communicated to all workers in a job briefing before work begins.

8.8.2 When more than one worker is involved in limbing, bucking, and moving debris from a tree, each shall be positioned and their duties organized so that the actions of one worker will not create a hazard for any other worker. Only one worker shall be cutting a single tree or single tree part during the limbing and bucking process.

8.8.3 Before bucking or limbing wind-thrown trees, precautions shall be taken to prevent the root ball or butt log from striking a worker.

8.8.4 Chain saws should be operated away from the vicinity of the legs and feet. Natural barriers, such as limbs between the saw and the body, should be employed where possible. While operating a chain saw, the preferred working position is on the uphill side of the work.

8.8.5 The worker shall ensure firm footing before and during limbing and bucking. The worker shall not stand on loose debris or logs that may roll when the log being bucked is cut.

8.8.6 Trees, limbs, or saplings under tension shall be considered hazardous. Appropriate cutting techniques and precautions shall be followed.

8.8.7 When necessary to prevent rolling, logs shall be blocked with wood or other suitable material.

8.8.8 Wedges should be used as necessary to prevent binding of the guide bar or chain when bucking.

8.8.9 Cant hooks or peaveys should be used as an aid in rolling large or irregular logs.

8.8.10 If mechanized equipment is used, the equipment operator shall establish an effective means of communication with other workers (see Subsection 8.5.11).

8.8.11 Workers shall not approach mechanized equipment operations until the equipment operator has acknowledged that it is safe to do so.

8.9 Pesticide Application

8.9.1 Pesticide applicators shall obtain and remain current with all licensing/certification requirements as required by the appropriate state regulatory authority prior to using pesticides.

8.9.2 Pesticide applicators shall follow all applicable laws and/or regulations pertaining to pesticide use, handling, and disposal.

8.9.3 The applicator shall follow label instructions in regard to pesticide applications.

8.9.4 Personal protective equipment shall be properly fitted, cleaned, maintained, and stored. Proper use of personal protective equipment as specified on the product label will reduce the risk of pesticide exposure to the applicator.

8.9.5 Personal protective equipment shall not be stored with pesticides.

8.9.6 Employee training shall be provided in the recognition of hazardous substances, proper handling, and emergency procedures in the event of a spill or accidental poisoning, as required by the OSHA 1910.1200 Hazard Communication standard and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

8.9.7 Safety Data Sheets (SDS) for all products in inventory shall be reviewed with and made available to all affected employees. All SDSs pertaining to pesticides in use shall be readily available on the work site.

8.9.8 The applicator shall follow pesticide label instructions in regard to laundering his/her clothing.

8.9.9 The applicator should shower or bathe at the end of each workday.

8.9.10 The employer shall provide a clean water source at the worksite, which may be used for emergency personal decontamination. Precautions shall be taken to prevent contamination of the clean water source. Drinking water and decontamination water shall be kept in separate containers and each labelled.

8.9.11 The applicator shall not direct a solid spray column into contact with electrical conductors.

8.9.12 Pesticides shall be stored in their original container or in a clearly marked service container.

8.9.13 Pesticides shall be stored in locked compartments.

8.9.14 Pesticide storage areas shall meet or exceed all applicable state and local regulations.

8.9.15 An emergency action plan, including spill response materials and procedures, shall be available where pesticides are stored, transported, or handled.

8.10 Mixing Pesticides

8.10.1 Pesticides shall be mixed in an area that is outdoors or in a well-ventilated, illuminated, enclosed area.

8.10.2 Devices used for mixing and measuring pesticides shall be specifically designated and marked for pesticide use and shall be used for no other purpose.

8.11 High-Pressure Air-Excavation Equipment

8.11.1 Personal protective equipment shall be required for the operator and all crew members within the worksite and shall include hard hat with attached face shield, hearing protection, eye protection, and gloves. Additionally, long pants, a long-sleeved shirt, and/or coveralls shall be worn.

8.11.2 Respiratory protection should be worn when conditions warrant. When used, respiratory protection shall be in accordance with the OSHA 1910.134 Respiratory Protection standard.

8.11.3 A proper worksite shall be identified; measures shall be taken to keep non-involved individuals clear of the worksite.

8.11.4 The compressor operator shall understand and follow all operating instructions for the compressor.

8.11.5 The air hose shall be properly attached and secured to the compressor prior to starting the compressor.

8.11.6 Body parts shall not be placed in front of air jets.

8.11.7 When the operator is finished, the air line shall be depressurized prior to uncoupling the air hose.

8.12 Fertilization/Soil Management

8.12.1 Fertilization should be conducted in accordance with the ANSI A300 (Part 2) standard.

8.12.2 All products should be used in accordance with manufacturers' safety recommendations.

8.12.3 Fertilizers shall be stored away from ignition sources and separate from petroleum products and pesticides.

8.12.4 Smoking shall be prohibited in the fertilizer storage area.

ANNEX A
(Informative)
Glossary of Terms for ANSI Z133

NOTE: The numbers in parentheses after these terms are cross-references to the section in the standard where the term is first used in a major context. See index for other uses of these terms in the standard.

aerial device (4.1.4[e]): Any one of the following types of vehicle-mounted apparatus used to elevate personnel to work positions aloft:

- extensible boom platform
- aerial ladder
- articulating boom platform
- vertical tower
- a combination of any of the above, as defined in ANSI A92.2

apex (8.6.13.1): The point at which two saw cuts meet to form a notch.

applicator (5.4.3): A qualified person engaged in the application of materials such as, but not limited to, pesticides, growth regulators, and fertilizers.

approved (3.3.7): Acceptable to the federal, state, or local jurisdiction having enforcement authority.

approved containers (3.6.2[b]): Containers having a spring-closing lid and spout cover designed to safely relieve internal pressure when subjected to fire exposure.

arboriculture (1.1): The art, science, technology, and business of utility, commercial, and municipal tree care.

arborist (1.2): An individual engaged in the profession of arboriculture.

arborist climbing line (5.7.11): A rope designated to support the climber while aloft in a tree or attached to a crane, constructed according to specifications outlined in subsection 8.1.7.

arborist saddle (5.7.11): A body-holding device that fastens around the waist and around the thighs with or without an integrated rigid seat; used by arborists in conjunction with other components for work positioning and suspension in trees (a.k.a. tree saddle, sit harness).

authorized (5.1.7): Designated by the entity that has care, custody, and control of the unit.

authorized person (5.3.7): A person approved or assigned by the employer to perform a specific type of duty or duties or to be at a specific location or locations at the worksite.

back cut (8.6.13): The cut made in a tree limb or trunk on the side opposite the intended direction of fall.

backstay (8.5.9): A rope or cable that is set to share the load on a spar, limb, jib, pole, or other load-bearing member.

barber chair (8.6.14): Dangerous condition created when a tree or branch splits upward vertically from the back cut (a.k.a. slab up).

blind pick (5.7.13): A work situation where the qualified arborist or the load is not in full view of the qualified crane operator.

boom-supported elevating work platform (5.2.32): A self-propelled, integral-chassis aerial platform that can be positioned completely beyond the base and used to position personnel, along with their necessary tools and materials, at work locations. Aerial platforms are power-operated, and primary functions, including drive, are controlled from the platform. Such aerial platforms are intended to be occupied when driven.

brush hog (5.8.3): A heavy-duty rotary mower, normally pulled by a farm-type tractor, used for cutting and mulching brush.

bucket (5.2.9): See *platform*.

bucking (8.8.1): The act of sawing trees, limbs, or both, into smaller sections once they are on the ground.

cant hook (7.2.2): A long-handled lever fixed with a blunt metal end to handle logs; includes a swinging, metal hook opposing the blunt end to create leverage.

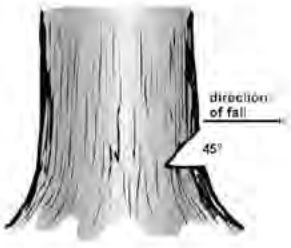
carabiner (5.2.7.2): A connector generally composed of a trapezoidal or oval-shaped body with a closed gate or similar arrangement that may be opened to receive an object and, when released, automatically closes to retain the object.

chopping tool (7.4.2): A wooden-, fiberglass-, or steel-handled tool with a sharp, single- or double-edged steel head or blade mounted to it that is used to cut or split wood (for example, an ax or machete).

compatible (5.9.17): Parts of a system that are consistently capable of performing to specification when combined in specific arrangements.

conductive (4.1.4[a]): Capable of carrying an electrical current for the voltage likely to be present.

conventional notch (8.6.13.2): A directional felling cut into the side of a tree, facing the intended direction of fall and consisting of a horizontal face cut and an angle cut above it, creating a notch of approximately 45 degrees (see illustration).



crew leader (8.6.1): The qualified arborist designated as the individual in charge of a specific job or group of workers.

crotch (8.1.9): (*n.*) Branch union; the angle formed by two branches in the tree. (v.) To place a line through a branch union.

dbh (8.6.7): See *diameter at breast height.*

deadman control (5.8.3): A safety switch, electrical or mechanical, that deactivates the equipment's function when released by the operator.

de-energizing (4.3.12): Freeing from any electrical connection to a source of potential difference and from electric charge; not having a potential different from that of the earth.

diameter at breast height (8.6.7): Diameter of a tree measured at 4.5 feet (1.3 m) above ground.

dielectric (3.3.4): Nonconductive of electrical current.

digging (3.4.2): Any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal, including but not limited to tree planting, stump grinding, or trenching.

direct contact (4.1.4[b]): When any part of the body touches or contacts an energized electrical conductor.

direct supervision (3.4.1): When a qualified arborist or a qualified arborist supervisor is physically present on the jobsite.

drop-starting (6.3.4): The act of starting a chain saw by pushing the saw away from the body with one hand while simultaneously pulling on the starter cord handle with the other.

drop zone (3.4.6): Area beneath workers aloft involved in arboricultural operations and/or where the potential exists for struck-by injuries from falling objects.

electrical conductor (3.3.4): Any overhead or underground electrical device capable of carrying an electric current, including communications wires and cables, power lines, and other such fixtures or apparatus.

electrical hazard (3.4.7): An object or situation that poses risk of injury or death due to direct or indirect contact with an electrical conductor. Where unguarded, energized electrical conductors are present, specific minimum approach distances based on the arborist's or worker's level of training, as set forth in this standard, shall be followed.

electrical system owner/operator (4.3.12): An organization that operates or controls the transmission and/or distribution of electric power through electrical conductors.

employer (1.3): A person or entity engaged in a business or work activity who has employees working at his/her (their) direction, or the designated representative of this person or entity.

false crotch (8.1.9): A system, other than a natural crotch, used to support an arborist climbing line.

good working condition (8.3.7): A term describing a piece of equipment that has no mechanical defects, has all guards in place, and is operated as intended by the manufacturer.

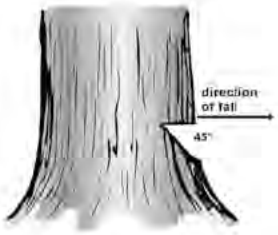
grounded (4.1.4[a]): A system, circuit, or apparatus provided with a ground(s) for the purposes of establishing a ground return circuit and for maintaining its potential at approximately the potential of earth.

ground fault (4.1.4[e]): Any undesirable current path from a current-carrying conductor to ground.

host employer [line clearance] (4.3.8): An employer that operates, or that controls the operating procedures for an electric power generation, transmission, or distribution installation on which a contract employer is performing work covered by Section 4.3.

hinge (8.6.13.5): Strip of uncut wood fibers created between the face cut or notch and the back cut that helps control direction in tree felling or limb removal (a.k.a. holding wood).

Humboldt notch (8.6.13.2): A directional felling cut into the side of a tree, facing the intended direction of fall and consisting of a horizontal face cut and an angled cut below it, creating a notch of approximately 45 degrees (see illustration). A Humboldt cut is usually reserved for larger trees on steep slopes.



incidental line clearance (4.2.4): tree work performed where an electrical hazard exists to the arborist, but the arborist is not working for the purpose of clearing space around the conductor on behalf of the utility that controls or operates the wires/lines.

indirect contact (4.1.4[b]): When any part of the body touches any conductive object, including tools, tree branches, trucks, equipment, or other objects, that is in contact with an energized electrical conductor. Such contact can also be made as the result of communication wires and cables, fences, or guy wires being accidentally energized.

insulated (4.1.13): Resistant to the flow of electricity for the voltage which it is rated.

job briefing (3.4.3): The communication of at least the following subjects for arboricultural operations: hazards associated with the job, work procedures involved, special precautions, electrical hazards, job assignments, and personal protective equipment.

kilovolt (kV) (Table 1): The term for 1,000 volts, abbreviated as kV. Higher voltages are generally given as kilovolts. Example: 12.5 kV (12,500 volts) and 19.9 kV (19,900 volts).

kilonewton (kN) (8.2.4): The measurement of force, abbreviated as kN. Equal to 224.8 pounds. Example: 24.02 kilonewtons equals 5,400 pounds.

ladder (4.1.12): A two-, three-, or four-legged structure that utilizes vertical side legs with cross sections uniformly placed between the side legs to be used as steps; available in wood, aluminum, or fiberglass; used to ascend to and descend from a height. Also see *tripod/orchard ladder.*

lanyard

tool lanyard (8.4.3): Short line or strap used to secure a tool while working aloft.

work-positioning lanyard (6.3.6): A component of a climbing system, used for work positioning, consisting of a flexible line of rope or a strap that may incorporate a knot or mechanical device to allow for adjustability.

leg protection (3.3.8): Personal protective equipment intended to reduce the risk of injury to the legs during chain saw operations.

limbing (8.8.1): See *bucking*.

line
(The following three terms are often used interchangeably)

handline (7.1.6): Rope designated as a tool to leverage, lift, and hold tools, equipment, wood, or other objects.

tagline (8.5.14): Rope used during the removal of limbs or other portions of trees, or whole trees during tree removal operations. The line is used to introduce force to influence the direction of fall of the piece being cut. In pruning and rigging operations, the line may also be used to direct the piece as it is being lowered.

workline (8.1.3): Rope used for lifting, lowering, or guiding limbs or equipment, or both, into or out of the tree.

line clearance (4.3.6): The pruning, trimming, repairing, maintaining, removing, treating, or clearing of trees or the cutting of brush (vegetation management) that is within the minimum approach distance (MAD) per Table 3 of electric supply lines and equipment; vegetation management work performed by qualified line-clearance arborists or qualified line-clearance arborist trainees for the construction or maintenance of electric supply lines and/or the electric utility right-of-way corridor.

load radius (5.7.11.8): The horizontal distance from the axis of rotation of the crane to the center of the vertical load rope or tackle with a load applied.

MAD (4.1.7): See *minimum approach distance.*

manual tree felling (8.6.4): The removal of a tree or tree trunk by an arborist from the ground by the incorporation of a notch and back cut.

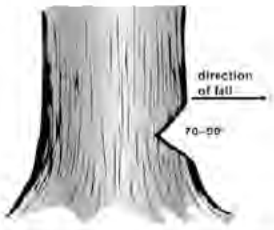
maul (7.3.7): A heavy hammer, sometimes made with a single edge; used to drive wedges or split wood.

minimum approach distance (MAD) (4.1.7): The closest distance an employee may approach to or bring any conductive object an energized or a utility system grounded object; or the closest distance the employee may to an energized or utility system grounded object, as outlined in Tables 1, 2, and 3 of this standard.

mitigate (4.3.12): To lessen or make less severe a hazardous condition or dangerous situation.

moving rope system (8.2.4): A climbing system in which the rope adjustment device advances along a moving climbing line. Doubled rope technique (DdRT) is an example of a moving rope system (contrast with *stationary rope system*).

open-face notch (8.6.13.2): A directional felling cut into the side of the tree, facing the intended direction of fall and consisting of two cuts that create a notch greater than 70 degrees (see illustration).



outrigger (5.2.5): Built-in device used to stabilize cranes, aerial devices, and similar equipment.

Personal Protective Equipment Hazard Certification (5.3.6): Documentation of the employer's workplace hazard assessment that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment.

pesticide (5.4.11.1): A substance used to manage unwanted plants, insects or animals.

phase-to-ground (4.1.4[b]): The electric potential (voltage) between a conductor and ground.

phase-to-phase (4.1.4[d]): The electrical potential (voltage) between two conductors, each having its own electric potential relative to ground.

platform (4.1.13): The personnel-carrying component of an aerial device, such as a bucket, basket, stand, or equivalent.

primary conductor (4.3.9): Any conductor, including aluminum, copper, or aluminum conductor steel-reinforced (ACSR), that is bare, covered, or insulated, with a nominal voltage above 750 volts.

proximity (3.3.4): An area within 10 feet (3.05 m) of energized overhead electrical conductors rated 50 kV phase-to-phase or less. For overhead electrical conductors rated more than 50 kV phase-to-phase, the distance is increased by 4 inches for each additional 10 kV.

Prusik loop (8.2.6): An endless loop of rope used to fashion a Prusik knot. The endless loop may be spliced or knotted with, at minimum, a double-fisherman's knot.

qualified arborist (3.4.1): An individual who, by possession of a recognized degree, certification, or professional standing, or through related training and on-the-job experience, is familiar with the equipment and hazards involved in arboricultural operations and who has demonstrated ability in the performance of the special techniques involved.

qualified arborist trainee (6.1.5): An individual undergoing on-the-job training under the direct supervision of a qualified arborist. In the course of such training, the trainee becomes familiar with the hazards and equipment involved in arboricultural operations and demonstrates ability in the performance of the special techniques involved.

qualified crane operator (5.7.3): An individual who has demonstrated proficiency to operate the type and capacity of equipment he/she operates; is familiar with the equipment and hazards involved with arboriculture crane operations and has demonstrated proficiency in performing the special techniques involved; and where applicable, meets federal, state, or local requirements for licensure or training.

qualified line-clearance arborist (4.3.6): An individual who, through related training and on-the-job experience, is familiar with the equipment and hazards in line clearance and has demonstrated the ability to perform the special techniques involved and who is working on behalf of the system owner/operator.

qualified line-clearance arborist trainee (4.3.5): An individual undergoing line-clearance training under the direct supervision of a qualified line-clearance arborist (as defined above). In the course of such train-

ing, the trainee becomes familiar with the equipment and hazards in line clearance and demonstrates ability in the performance of the special techniques involved.

quick-acting connector (5.2.22): Hose connectors in a hydraulic or pneumatic system designed to allow rapid connection or disconnection without leakage when the system is pressurized.

secured

object (5.1.8): Made firm or tight; fastened. Example: The load is secured to the truck.

person-aerial lift operator (5.2.16): An aerial lift operator who is protected from a fall from an aerial lift by use of a fall-protection system.

person-climber (6.3.6): An arborist who is safeguarded from unintended movement by utilizing a climbing system that is attached to the arborist and connected to a tree or other stable support. Examples of being secured include, but are not limited to, (a) being tied in, (b) using a work-positioning lanyard, (c) being on belay, and (d) ascending the arborist climbing line using the footlock technique while utilizing a Prusik loop or ascenders.

shall (1.4): As used in this standard, denotes a mandatory requirement.

shock-loading (5.7.8): The force exerted by a falling or moving object on the structure supporting it, which is greater than the weight of the object (also called dynamic load).

should (3.1.3): As used in this standard, denotes an advisory recommendation.

snap hook (5.2.7.2): Commonly called a self-locking or double-locking rope snap. The locking type (required by this standard for climbing) has a self-closing, self-locking gate that remains closed and locked until intentionally opened by the user for connection or disconnection. A captive eye is an integral part of a snap hook but is independent of the hook and gate portion.

spar (8.1.14): A standing trunk or main stem of a tree without a crown and lateral limbs.

split-tail (8.2.1): Separate, short length of rope used to tie the climbing hitch in a climbing system.

spotter

aerial lift operations (5.2.27): A qualified person within voice and/or visual communication with the operator of an aerial lift who is located in a position to view the boom while it is aloft in order to help ensure clearances from obstacles and hazards such as; overhead energized lines, traffic, trees or other structures.

crane (5.7.3): A qualified person within voice and/or visual communication with the operator of a crane who is located in a position to view the boom, load line and load in order to help ensure clearances from obstacles and hazards such as; overhead energized lines, traffic, trees or other structures.

driving (5.1.13): A person within voice and/or visual communication of the driver and located in a position to view the area in which the vehicle (unit) is moving to help ensure that the operation is, and will remain, safe.

stationary rope system (8.2.5): A climbing system in which the rope adjustment device moves along a stationary climbing line (contrast with *moving rope system*).

step potential (4.1.4[f]): The voltage between the feet of a person standing near an energized grounded object. It is equal to the difference in voltage, given by the voltage distribution curve, between two points at different distances from the electrode. A person could be at risk of injury during a fault simply by standing near the grounding point.

suspended (load) (5.7.7): Any attached load held off the ground and against the force of gravity by the crane.

temporary traffic control zone (3.5.2): An area of highway, street, or road where road user conditions are changed by the use of temporary traffic control devices.

testing (4.3.12): To determine the presence of electricity.

tied in (5.7.11): An arborist whose climbing line has been run through a natural or false crotch, attached to an arborist's saddle and completed with a climbing hitch or mechanical device, permitting controlled movement and work positioning.

tripod/orchard ladder (7.5.8): A three-legged ladder that utilizes the third leg to form a tripod to stabilize itself among orchard trees and/or shrubs. It is recommended for use on turf for better stability and to avoid slippage of the legs. Not recommended for use on hard surfaces.

volt (V) (4.3.9): A unit of electric potential difference between two points. Lower-voltage systems are generally expressed in terms of volts; for example, 120 volts or 240 volts.

wedge (7.3.2): A piece of material with two sides meeting at an angle; used to raise or split objects by applying a driving force, such as with a hammer.

wheel chock (5.2.4): Wedge-shaped block manufactured or employer approved to prevent unintentional movement of vehicle. Wheel chocks are placed in front of or in back of a vehicle's tires or tracks. If necessary, the chocks can be placed both in front and in back of the tires or tracks.

working-load limit (8.5.3): The working load that must not be exceeded for a particular application as established by a regulatory or standards-setting agency (see *working load* under Additional Terms).

Additional Terms

action [rope snap, carabiner]: Single, specific motion (e.g. non-locking carabiner has one "action," the gate opening).

double-action: A connector with a gate capable of being opened only by at least two consecutive, deliberate actions (e.g. locking rope snap).

triple-action: A connector with a gate capable of being opened only by at least three consecutive, deliberate actions (e.g. carabiners used in life support).

aerial lift lanyard: A component of an aerial lift fall-protection system that connects the operator to an approved anchor.

ascender: A mechanical device used for climbing rope.

auto-locking: Type of connecting link, rope snap or carabiner, that when the gate is opened and released it closes and locks by itself (self-closing and self-locking).

belay: Roping technique, managed by another person, to safeguard the arborist while climbing.

climbing hitch: A hitch used for securing a tree climber to the climbing line, permitting controlled ascent, descent, and work positioning. Examples of climbing hitches include, but are not limited to, the tautline hitch, Blake's hitch, and the Prusik hitch.

electric supply: Conductors used to transmit electric energy and their necessary supporting or containing structures. Signal lines of more than 400 volts are always supply lines, and those of less than 400 volts are considered as supply lines if so run and operated throughout.

energy (shock) absorber: A component of a climbing system whose primary function is to dissipate energy and limit deceleration forces that the system imposes on the body during fall arrest.

fall-arrest lanyard: A rope or strap designed to be used with a full-body harness to limit maximum arresting force on a climber to 1,800 pounds (8 kN) in a fall.

false crotch for rigging: A pulley, block, sling, lashing, or metal ring affixed to a tree's leader or limb, through which a load line is passed, to lower or raise limbs or equipment.

footlock: To climb up a suspended rope by pulling with the hands and arms and pushing upward with the feet. The loose end of the rope is wrapped under the middle and over the top of one foot and is locked in place with pressure from the other foot.

friction point: The point at which the rope surface of the climber's hitch rubs against the climbing line.

guarded: Covered, fenced, enclosed, or otherwise protected by suitable covers or casings, barrier rails or screens, mats, or platforms that have been designed by the electrical system owner/operator to minimize the possibility of dangerous approach or accidental contact by persons or objects under normal conditions. Contrast with *unguarded*.

Prusik knot: A sliding friction knot, as in a work-positioning lanyard.

stored energy: Potential energy that is contained within an object (e.g. a suspended weight, a coiled spring, wood under tension, wires under tension, pressurized hydraulic lines, etc.).

unguarded: Not guarded from approach or contact with electrical conductors.

working load: Limiting load values derived from the minimum breaking strength of a cord or rope divided by the design factor. For example, given a minimum breaking strength of 10,000 pounds (44.48 kN) and a design factor of 10:

10,000/10 = 1,000 (working load, in pounds)

Or, given a minimum breaking strength of 10,000 pounds (44.48 kN) and a design factor of 5:

10,000/5 = 2,000 (working load, in pounds)

- The recommended design factor for personal fall-protection components, such as fall arrest, fall restraint, work positioning, and suspension cordage and connecting links, etc., is a minimum of 10:1.
- The recommended design factor for synthetic rigging components, such as rope, slings, cordage, etc., is a minimum of 5:1.
- The recommended design factor for metal rigging components, such as wire rope, metal connecting links, etc., is a minimum of 3:1.

work-positioning system: An arborist climbing system designed to be used under tension to limit falls to no more than two feet, and which supports the arborist on an elevated, vertical surface, such as a tree, and allows him/her to work with both hands free.

ANNEX B
(Informative)
Recommended Guidelines for Standard Performance and Safety Training for Qualified Line-Clearance Arborists/Qualified Line-Clearance Arborist Trainees and Qualified Arborists/Qualified Arborist Trainees

NOTE: The content of this training outline is generic and may be customized to achieve equivalent levels of safe practice by substituting or, where deemed appropriate to the circumstances, omitting portions of this outline. Use or nonuse of training aids that may be available shall not be evidence of noncompliance with this standard or annex.

B.1 General Requirements

Specific training in the area of individual expertise and work required of a qualified line-clearance arborist or qualified arborist should be provided by the employer and documentation of training retained on file for the duration of employment.

B.1.1 Introduction and employer/employee responsibilities

B.1.2 Employee orientation, to include:

- job description appropriate to job assignment (qualified line-clearance arborist or qualified arborist)
- introduction to immediate supervisor and crew members
- familiarization with appropriate personal protective clothing and equipment and its proper use and maintenance
- familiarization with equipment
- introduction to company policies, procedures, and safe work practices
- safe work practices as related to job assignments
- written acknowledgment by employee that he or she has participated in such training

B.1.3 Line-clearance or tree care pruning techniques appropriate to job assignments, as follows:

B.1.3.1 Provide education and training in accordance with prevailing national standards for utility pruning. Refer to Annex D, Additional Resources for further information.

B.1.3.2 Provide education and training in accordance with prevailing local, state, or regional standards for utility pruning, as well as those specified by utility contracts.

B.1.3.3 Provide tree knowledge for line-clearance or tree care techniques appropriate to job assignments.

B.1.3.4 Provide education and training relative to predominant tree species within geographic area, such as identification, growth habits, structure, and wood strength.

B.1.3.5 Provide education and training for recognition and evaluation of potentially hazardous conditions related to tree structure. Refer to recommended resources in Annex D.

B.2 General Safety

B.2.1 OSHA Standards
Familiarize employees with the requirements of federal and/or state OSHA standards as applicable to employee job assignments. Refer to recommended resources in Annex D.

B.2.2 American National Standards
Familiarize employees with the requirements in ANSI Z133 as applicable to employee job assignments. Refer to additional recommended standards in Annex D.

B.2.3 Public Safety and Traffic Control
Provide education and training in the use of public safety and traffic control devices as applicable under federal, state, or local regulations.

B.2.4 Electrical Hazards
Provide education and training in the recognition and avoidance of electrical hazards applicable to employee job assignments (line clearance or tree care).

B.2.5 Emergency Conditions
Provide education and training in the proper procedures for safely performing work in emergency conditions applicable to employee job assignments.

B.2.6 Jobsite Briefings
Provide education and training in jobsite-specific hazards associated with the job, work procedures, and practices involved. Instruct employees about special precautions, personal protective clothing, and equipment requirements as applicable to employee job assignments.

B.3 Personal Safety

B.3.1 Personal Protective Equipment
Provide personal protective equipment as required for applicable job assignments, and instruct employees in its proper use, fit, life, and maintenance.

B.3.2 Emergency Response Procedures
Furnish employees with appropriate information and training necessary to expedite a response to a worksite emergency, such as first aid, CPR, and aerial rescue (see Annex F, Aerial Rescue Flowchart).

B.3.3 Prevention of Back and Other Injuries
Provide education and training in the techniques required to avoid back and other injuries applicable to job assignments.

B.3.4 Identification and Avoidance of Animals and Poison Plants
Provide education and training in the identification of and the need to avoid contact with poisonous plants and instructions for treating insect stings/bites and snake bites.

B.4 Equipment Safety

B.4.1 Mobile Equipment and Aerial Lifts

Provide education and training in the inspection, operation, and maintenance of all vehicles and equipment, such as aerial lifts, brush chippers, stump grinders, log loaders, tree cranes, mowing equipment, and pesticide application equipment. All equipment shall comply with applicable federal and state regulations, local ordinances, and manufacturers' operating instructions. Such training shall be appropriate to employee job assignments.

B.4.2 Aerial Equipment and Electrical Hazards

Provide education and training so that affected employees understand the required and recommended procedures for operating aerial devices in proximity to electrical hazards. Such training shall be appropriate to employee job assignments.

B.4.3 Chain Saw, Power Tool, and Hand Tool Use and Safety

Provide education and training in the safe use of chain saws, power tools, and hand tools in accordance with manufacturers' instructions. Such training shall be appropriate to employee job assignments.

B.4.4 Climbing Equipment Use and Safety

Provide education and training in the inspection, maintenance, and storage of climbing equipment such as ropes, saddles, personal lanyards, rope snaps, carabiners, and related equipment. Such training shall be appropriate to employee job assignments.

B.5 Operational Safety

B.5.1 Climbing Techniques

Provide education and training in climbing techniques as appropriate to employee job assignments.

B.5.2 Rigging and Tree Removal

B.5.2.1 Provide education and training appropriate to employee job assignments, such as knots and ropes, rigging techniques, tree strength and weight characteristics, and potential electrical hazards.

B.5.2.2 Provide education and training in the identification and removal of hazard trees. Such training shall be appropriate to employee job assignments.

B.5.3 Hazard Communications

Provide education and training necessary to comply with federal and state regulations appropriate to employee job assignments.

B.5.4 Pesticide Use

Provide education and training necessary to comply with federal and state regulations appropriate to employee job assignments.

ANNEX C
(Informative)
General Safety Procedures That Apply to All Tree Work

C.1 Lifting

Before lifting any weight, workers should

(a) be sure there is a clear path available if the weight is to be carried from one place to another;

(b) decide exactly how the object should be grasped to avoid sharp edges, slivers, splinters, or other factors that might cause injury;

(c) make a preliminary lift to be sure the load can be safely handled;

(d) place feet solidly on the walking surface;

(e) crouch as close to the load as possible, with legs bent at an angle of about 90 degrees;

(f) lift with the legs, not the back, keeping the weight as close to the body as possible; and

(g) use additional workers or material-handling equipment when necessary.

C.2 Control of Hazardous Energy

When a worker, hereafter referred to as the "authorized person," is doing mechanical work, precautions must be taken to prevent injury caused by moving or elevated parts, or the release of stored energy, such as hydraulic pressure. Failure to do so could result in a serious, potentially maiming, or fatal injury. The authorized person performing maintenance/repair shall comply with the manufacturers' procedures.

The specific Control of Hazardous Energy requirements established by the Occupational Safety and Health Administration (OSHA) may be obtained by consulting 29 CFR 1910.147 or by writing to the Department of Labor, OSHA, 200 Constitution Avenue NW, Washington, DC 20210.

Sample Procedures

Sequence for Securing Equipment (Sample)

1. The authorized person shall notify the crew and/or affected employees that maintenance or repair is to be done and that such equipment must be shut down and secured.
2. The authorized person shall refer to the manufacturer's manual for proper procedures (as needed).
3. If equipment is in an operational mode, it shall be shut down by normal procedures.
4. Rotating parts, such as chipper blades, shall be stopped before maintenance or repair. Keyed ignition systems must be in working order.
5. Keys shall be removed and pocketed by the foreman or mechanic. When there is no keyed ignition system, the battery cables or spark plug wires may be disconnected.
6. The power takeoff should be disengaged before beginning service or repair tasks, such as hose replacement. All hydraulic tools should be disconnected before equipment is adjusted or serviced.
7. An employee shall never attempt to stop a hydraulic leak with his/her body.
8. Materials or parts that must be raised or disconnected and suspended shall be properly secured, such as with an appropriate sling or jackstand. Flywheels, such as chipper cutter heads, are to be blocked to prevent pinch points.
9. Before proceeding with maintenance or repair, the authorized person shall ensure that equipment is isolated and will not operate.
10. Any piece of equipment being serviced or repaired shall not be started, energized, or used by any other worker not under the direction of the authorized person.
11. When the engine must be running for tuning or adjustment, special care must be given to moving parts.

Restoring Equipment to Service (Sample)

When maintenance or repair is complete and equipment is ready to return to normal operation, the following steps shall be taken by the authorized person to restore the equipment to service:

1. To prevent accidental contact with moving or electrical components when the equipment is engaged, check for loose parts or tools that may have been left in the immediate area.
2. Ensure that all guards are in place and employees are in the clear.
3. Confirm that controls are in neutral.
4. Reconnect key, cable, or plug wires.
5. Notify affected employees that equipment is ready to return to service.

C.3 Manual Tree Felling Procedure

Before performing any work, conduct a site assessment and the following seven steps to determine whether a tree can be manually felled.

1. **Hazards and Obstacles Identification:** Example of conditions to analyze include, but are not limited to
   - (a) tree size in relationship to the landing zone;
   - (b) selected direction of fall;
   - (c) obstacles to avoid or clear from the felling path;
   - (d) vines or interlocking limbs;
   - (e) species and shape of tree;
   - (f) lean of tree;
   - (g) loose limbs, hangers, broken tops, chunks, or other overhead material;
   - (h) wind force and direction;
   - (i) decay, cavities, or weak spots throughout the tree;
   - (j) location of any electrical conductors or other wires;
   - (k) tree cables, bracing, lightning protection, or other tree hardware;
   - (l) size and terrain characteristics or limitations of work area;
   - (m) potential for flying debris from tree impact;
   - (n) adequate retreat path;
   - (o) evidence of bees or wildlife habitation in tree;
   - (p) poisonous plants;
   - (q) water hazards;
   - (r) ability to control access to worksite;
   - (s) authority to remove tree;
   - (t) quality of wood fiber in hinge area;
   - (u) root mass stability;
   - (v) ice or snow load;
   - (w) throwback or bounceback potential;
   - (x) potential for spring poles;
   - (y) lodged trees or dead snags in area;
   - (z) access to tools or resources required for task;
   - (aa) lightning damage;
   - (bb) potential for barber chair;
   - (cc) foreign objects, nails, wire fence, concrete, etc.

2. **Lean(s):** Determine side lean from the fall direction, then go 90 degrees adjacent and determine front or back lean. (Note: The side lean may influence the retreat path [escape route] as well as the back cut to be used. Heavy, forward-leaning trees may represent a risk of barber chair.)

3. **Retreat Path/Escape Route** (planned retreat direction): Select a route that is 45 degrees to the rear of the tree and, when possible, to the opposite side of the natural side lean of the tree.

4. **Notch Plan:** Select and cut a notch that is best suited to allow the tree to fall safely in the desired direction (open face, conventional, or Humboldt).

5. **Hinge Plan:** Determine the type and characteristics of the hinge. Uncut wood between the notch and back cut is recommended to have a width that is 10 percent of dbh and a hinge length that is 80 percent of the tree's diameter.

6. **Back Cut Plan:** Select and make a felling cut, such as bore cut, stepped cut(s), or level back cut(s); also use assistance, such as wedge(s), workline(s), or machinery. Before making a back cut, give an audible command, such as "stand clear," and wait for a response, such as "all clear."

7. **Retreat:** Use a retreat path (escape route) out to a safe distance. If the tree has not fallen, use workline(s) or machinery in place to start the fall of the tree. Once the tree is on the ground, wait for movement to stop and check for hanging or lodged hazards before approaching.

ANNEX D
(Informative)
Additional Resources

D.1 Applicable American National Standards

Boom-Supported Elevating Work Platforms (ANSI/SAIA A92.5-2006 [R2014])

High-Visibility Safety Apparel and Accessories (ANSI/ISEA 107-2015)

Industrial Head Protection (ANSI/ISEA Z89.1-2014)

Ladders - Portable Metal - Safety Requirements (ANSI ASC A14.2-2007)

Ladders - Wood - Safety Requirements (ANSI ASC A14.1-2007)

Minimum Requirements for Workplace First Aid Kits and Supplies (ANSI/ISEA Z308.1-2015)

Occupational and Educational Personal Eye and Face Protection Devices (ANSI/ISEA Z87.1-2015)

Practices for Respiratory Protection (ANSI/ASSE Z88.2-2015)

Tree, Shrub, and Other Woody Plant Management—Standard Practices [Pruning] (A300 [Part 1]-2017)

Tree, Shrub, and Other Woody Plant Management—Standard Practices [Soil Management a. Modification, b. Fertilization, and c. Drainage] (A300 [Part 2]-2011)

Tree, Shrub, and Other Woody Plant Management—Standard Practices [Supplemental Support Systems] (A300 [Part 3]-2013)

Vehicle-Mounted Elevating and Rotating Aerial Devices (ANSI/SAIA 92.2-2015)

Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall and Roof Openings; Stairs and Guardrails Systems (ANSI/ASSE A1264.1-2007)

D.2 Other Applicable Standards

Articulating Boom Cranes (ASME B30.22-2016)

Mobile and Locomotive Cranes (ASME B30.5-2011)

Multiposition Small Engine Exhaust System Fire Ignition Suppression (SAE Standard J335_2012101)

Standard Specification for Leg Protection for Chain Saw Users (ASTM F1897-14)

Standard Specifications for Personal Climbing Equipment (ASTM F887-13)

Standard Test Method for Measurement of Cut Resistance to Chainsaw in Lower Body [Legs] Protective Clothing (ASTM F1414-15)

USDA Forest Service Standard for Spark Arresters for Internal Combustion Engines (USDA Forest Service Specification 5100-1d [February 2013])

D.3 Applicable Federal Regulations (Occupational Safety and Health Administration, Federal Motor Carrier Safety Administration, and Federal Highway Administration)

Control of Hazardous Energy (29 CFR 1910.147)

Electric Power Generation, Transmission, and Distribution (29 CFR 1910.269)

Electrical (29 CFR 1910, Subpart S [1910.331–1910.335])

Federal Motor Carrier Safety Regulations (49 CFR Part 390)

Fire (36 CFR 261.52)

Hazard Communication (29 CFR 1910.1200)

Manual on Uniform Traffic Control Devices (23 CFR, Part 655, Subpart F)

Permit-Required Confined Spaces (29 CFR 1910.146)

Personal Protective Equipment (29 CFR 1910, Subpart I [1910.132–1910.138])

Slings (29 CFR 1910.184)

D.4 Other Resources

Cordage Institute Rope Standards/The Cordage Institute (www.ropecord.com)

Globally Harmonized System of Classification and Labelling of Chemicals [GHS] (https://www.osha.gov/dsg/hazcom)

National Institute for Occupational Safety and Health/Fatality Assessment and Control Evaluation Program (www.cdc.gov/niosh/face)

Occupational Safety and Health Administration/Safety and Health Topics/Tree Care Industry (www.osha.gov/SLTC/treecare)

Occupational Safety and Health Administration/Safety and Health Topics/Landscape and Horticultural Services (www.osha.gov/SLTC/landscaping)

Personal Protective Equipment for the Prevention of Falls from a Height—Low Stretch Kernmantel Ropes (BS EN 1891:1998)

D.5 Associations

International Society of Arboriculture; P.O. Box 3129, Champaign, IL 61826-3129 (www.isa-arbor.com)

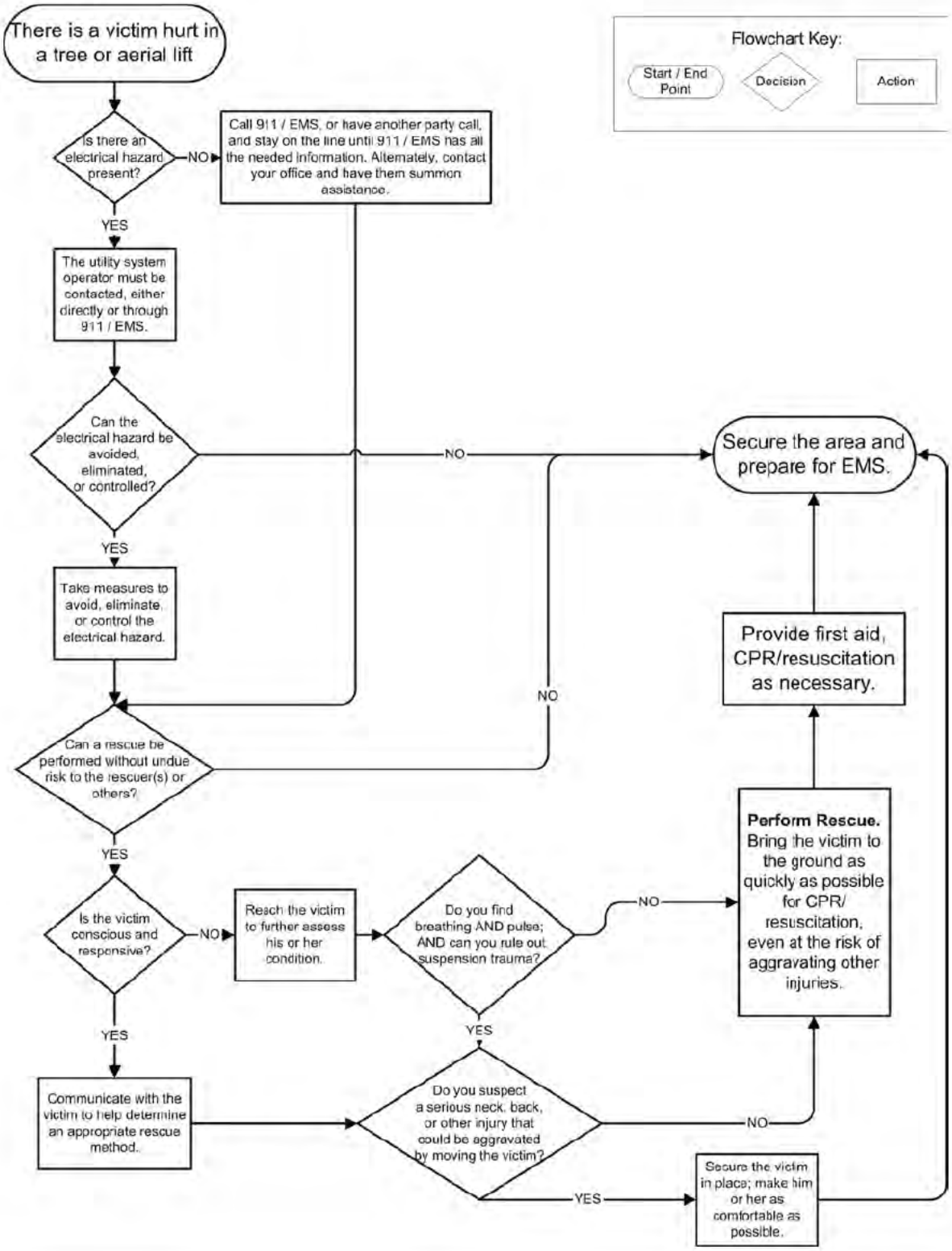
Tree Care Industry Association, Inc.; 136 Harvey Road, Suite 101, Londonderry, NH 03053 (www.tcia.org)

ANNEX E
(Informative)
Weight of Green Logs

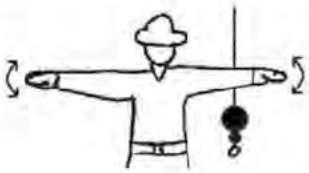
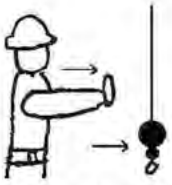
Scientific name	Common name	Weight, lb per ft^3	Weight of a 1-foot section, based on average diameter							
			10″	12″	14″	16″	18″	20″	22″	24″
Abies concolor	white fir	47	25	37	50	66	83	102	124	148
Abies procera	noble fir	29	16	23	31	41	51	63	77	91
Acer rubrum	red maple	50	27	39	53	70	88	109	132	157
Acer saccharinum	silver maple	45	25	35	48	63	79	98	119	141
Acer saccharum	sugar maple	56	31	44	60	78	99	122	148	176
Aesculus hippocastanum	horsechestnut	41	22	32	43	57	72	89	108	129
Alnus rubra	red alder	46	25	36	49	64	81	100	121	144
Betula papyrifera	paper birch	50	27	39	53	70	88	109	132	157
Calocedrus decurrens	incense-cedar	45	25	35	48	63	79	98	119	141
Carya illinoensis	pecan	61	33	48	65	85	108	133	161	192
Carya ovata	shagbark hickory	64	35	50	68	89	113	140	169	201
Celtis occidentalis	hackberry	50	27	39	53	70	88	109	132	157
Diospyros virginiana	persimmon	63	34	49	67	88	111	137	166	198
Eucalyptus camaldulensis	red gum	50	27	39	53	70	88	109	132	157
Fagus spp.	beech	54	29	42	58	75	95	118	142	169
Fraxinus americana	white ash	48	26	38	51	67	85	104	126	150
Fraxinus latifolia	Oregon ash	48	26	38	51	67	85	104	126	150
Fraxinus pennsylvanica	green ash	47	25	37	50	66	83	102	124	148
Gleditsia triacanthos	honeylocust	61	33	48	65	85	108	133	161	192
Juglans nigra	black walnut	58	32	45	62	81	102	126	153	182
Larix spp.	larch	51	28	40	54	71	90	111	135	160
Liquidambar styraciflua	sweetgum	55	30	43	58	77	97	120	145	173
Liriodendron tulipifera	yellow poplar, tuliptree	38	21	30	40	53	67	83	99	199
Melia azedarach	Chinaberry	50	27	39	53	70	88	109	132	157
Nyssa sylvatica	black gum	45	25	35	48	63	79	98	119	141
Picea rubens	red spruce	34	19	27	36	47	60	74	90	106
Picea sitchensis	Sitka spruce	32	17	25	34	45	56	70	84	100
Pinus contorta	lodgepole pine	39	21	30	41	55	69	85	103	122
Pinus elliottii	slash pine	58	32	45	62	81	102	126	153	182
Pinus lambertiana	sugar pine	52	28	41	55	72	92	113	137	163
Pinus monticola	western white pine	36	20	28	38	50	64	78	95	113
Pinus palustris	longleaf pine	55	30	43	58	77	97	120	145	173
Pinus ponderosa	ponderosa pine	46	25	36	49	64	81	100	121	144
Pinus strobus	eastern white pine	36	20	28	38	50	64	78	95	113
Pinus taeda	loblolly pine	53	29	41	56	74	93	116	140	166
Platanus occidentalis	sycamore	52	28	41	55	72	92	113	137	163
Populus spp.	cottonwood	49	27	38	52	68	86	107	129	154
Populus tremuloides	quaking aspen	43	23	34	46	60	76	94	114	135

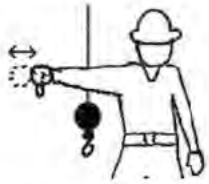
Scientific name	Common name	Weight, lb per ft^3	Weight of a 1-foot section, based on average diameter							
			10″	12″	14″	16″	18″	20″	22″	24″
Prunus serotina	black cherry	45	25	35	48	63	79	98	119	141
Pseudotsuga menziesii	Douglas-fir	39	21	30	41	55	69	85	103	122
Quercus alba	white oak	62	34	48	66	86	109	135	163	194
Quercus coccinea	scarlet oak	64	35	50	68	89	113	140	169	201
Quercus kelloggii	California black oak	66	36	51	70	92	116	144	174	207
Quercus palustris	pin oak	64	35	50	68	89	113	140	169	201
Quercus robur	English oak	52	28	41	55	72	92	113	137	163
Quercus rubra	red oak	63	34	49	67	88	111	137	166	198
Quercus stellata	post oak	63	34	49	67	88	111	137	166	198
Quercus virginiana	live oak	76	41	60	81	106	134	166	200	238
Robinia pseudoacacia	black locust	58	32	45	62	81	102	126	153	182
Salix spp.	willow	32	17	25	34	45	56	70	84	100
Sequoia sempervirens	coast redwood	50	27	39	53	70	88	109	132	157
Taxodium distichum	baldcypress	51	28	40	54	71	90	111	135	160
Thuja plicata	western red cedar	28	15	22	30	39	49	61	74	88
Tilia americana	basswood	42	23	33	45	59	74	92	111	132
Tsuga canadensis	eastern hemlock	49	27	38	52	68	86	107	129	154
Tsuga heterophylla	western hemlock	41	22	32	43	57	72	89	108	129
Ulmus americana	American elm	54	29	42	58	75	95	118	142	169

ANNEX F
(Informative)
Aerial Rescue Flowchart



ANNEX G
(Informative)
Hand Signals for Crane Operations

 **STOP** – With arm extended horizontally to the side, palm down, arm is swung back and forth.	 **EMERGENCY STOP** – With both arms extended horizontally to the side, palms down, arms are swung back and forth.	 **HOIST** – With upper arm extended to the side, forearm and index finger pointing straight up, hand and finger make small circles.
 **RAISE BOOM** – With arm extended horizontally to the side, thumb points up with other fingers closed.	 **SWING** – With arm extended horizontally, index finger points in direction that boom is to swing.	 **RETRACT TELESCOPING BOOM** – With hands to the front at waist level, thumbs point at each other with other fingers closed.
 **RAISE THE BOOM AND LOWER THE LOAD** – With arm extended horizontally to the side and thumb pointing up, fingers open and close while load movement is desired.	 **DOG EVERYTHING** – Hands held togehter at waist level.	 **LOWER** – With arm and index finger pointing down, hand and finger make small circles.
 **LOWER BOOM** – With arm extended horizontally to the side, thumb points down with other fingers closed.	 **EXTEND TELESCOPING BOOM** – With hands to the front at waist level, thumbs point outward with other fingers closed.	 **TRAVEL/TOWER TRAVEL** – With all fingers pointing up, arm is extended horizontally out and back to make a pushing motion in the direction of travel.

 **LOWER THE BOOM AND RAISE THE LOAD** – With arm extended horizontally to the side and thumb pointing down, fingers open and close while load movement is desired.	 **MOVE SLOWLY** – A hand is placed in front of the hand that is giving the action signal.	 **USE AUXILIARY HOIST** (whipline) – With arm bent at elbow and forearm vertical, elbow is tapped with other hand. Then regular signal is used to indicate desired action.
 **CRAWLER CRANE TRAVEL, BOTH TRACKS** – Rotate fists around each other in front of body; direction of rotation away from body indicates travel forward; rotation toward body indicates travel backward.	 **USE MAIN HOIST** – A hand taps on top of the head. Then regular signal is given to indicate desired action.	 **CRAWLER CRANE TRAVEL, ONE TRACK** – Indicate track to be locked by raising fist on that side. Rotate other fist in front of body in direction that other track is to travel.
 **TROLLEY TRAVEL** – With palm up, fingers closed, and thumb pointing in direction of motion, hand is jerked horizontally in direction trolley is to travel.		

Reprinted from Cranes and Derricks in Construction (29 CFR Part 1926).

ANNEX H
(Informative)
Electrical Hazard Abatement

(See Section 4.3.12 of the Standard)

H.1 Abatement

When an arborist cannot safely maintain the applicable minimum approach distance from energized electric conductors, or arborist work cannot be safely completed with the line energized, the arborist must stop work on that assignment until an electrical hazard abatement plan is implemented.

An electrical hazard abatement plan may include a request for the utility to de-energize, test, and ground the electric supply lines at the worksite to make it as safe as practicable for the arborist to work closer to de-energized conductors than allowed when the conductors are electrically energized. For non-line-clearance-qualified arborists, the hazard abatement plan may require they hire a qualified line-clearance arborist or contractor to perform the work.

H.2 Communication

When an arborist's electrical hazard abatement plan includes a request that the electrical system owner/operator de-energize, test, and ground the electrical conductors, precautions must be taken to ensure clear and thorough communications between the arborist and the onsite, qualified utility employee responsible for de-energizing and grounding the conductors. Failure to effectively communicate and maintain safe work practices could result in severe, potentially fatal injury.

H.3 General Requirements

1. The electrical system owner/operator has the expertise, responsibility, and authority for de-energizing, testing, grounding, and re-energizing the conductors.

2. Arborist employees shall treat all conductors and equipment as energized and maintain minimum approach distances to energized conductors until they have confirmed that the utility has de-energized and tested the line and that grounding is in place to make the electric supply lines as safe as practicable for arborist work.

3. Arborists shall avoid all direct contact with the de-energized conductors, because de-energized lines should never be considered 100 percent electrically safe under all conditions.

4. Arborists shall avoid dropping brush/limbs on the de-energized electric supply lines, poles, or equipment.

Sample Procedures

Sequence for working in proximity to de-energized and grounded electrical conductors

1. The arborist supervisor shall request that the designated utility supervisor in charge coordinate communications and actions between the arborist crew leader and the utility crew leader performing the de-energizing, testing, and grounding (i.e., times, locations, and designated contact persons at worksite where de-energizing, testing, and grounding is to apply).

2. At the worksite, a designated arborist employee in charge will be identified to the designated qualified utility employee in charge of de-energizing, testing, and grounding the conductors.

3. All arborist employees will maintain minimum approach distances until the arborist employee in charge has been notified by the qualified utility employee in charge that

    a. the de-energizing, testing, and grounding has been completed in accordance with the electrical system owner/operator's grounding procedures, creating a safety zone for the arborist to perform work; and

    b. the designated arborist employee in charge has visually confirmed, with the guidance of the designated qualified utility employee applying the grounds, that protective ground(s) have been installed as close as practicable to the line-clearance or arborist work to be performed to prevent hazardous differences in electrical potential.

4. It may be necessary to have the protective grounds moved by the utility if the arborist work progresses beyond the original worksite. If the grounds must be moved, Steps 1 through 3 must be repeated. The arborist crew leader must be able to visually confirm that protective ground(s) have been installed as required by the utility.

Sequence for re-energizing conductors

1. After completing the line-clearance or arborist work, the designated arborist employee in charge will verify that all arborist employees are outside of the minimum approach distances from the electric supply lines. The arborist will then inform the designated qualified utility employee in charge that the work is complete and that arborist employees are outside of the minimum approach distances. The qualified utility employee(s) may now re-energize the lines.

2. The arborist employees shall immediately treat the electrical conductors as energized and resume maintaining minimum approach distances as specified in Table 3 (for qualified line-clearance arborists) or Table 1 (for qualified arborists).

ANNEX I
(Informative)
Fall-Protection Systems

Work-Positioning System
Equipment designed to position the user at an elevated worksite in order that he may have free use of both hands. Not intended to arrest a fall.

Fall-Restraint System
Equipment designed and used to prevent the worker from reaching an area where a free fall could occur.

Fall-Arrest System
A product specifically designed to arrest a fall from an elevated position.

Suspension System
Equipment designed to suspend or lower a person to a worksite. Not intended to arrest a fall.

Images courtesy of Buckingham Manufacturing Co., Inc.

ANNEX J
(Informative)
Live-Line Tools

(From 29 CFR 1910.269 – Electric Power Generation, Transmission, and Distribution)

(j) Live-line tools

(1) ***Design of tools.*** Live-line tool rods, tubes, and poles shall be designed and constructed to withstand the following minimum tests:

(i) If the tool is made of fiberglass-reinforced plastic (FRP), it shall withstand 328,100 volts per meter (100,000 volts per foot) of length for 5 minutes, or

Note to paragraph (j)(1)(i): Live-line tools using rod and tube that meet ASTM F711-02 (2007), *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools,* are deemed to comply with paragraph (j)(1) of this section.

(ii) If the tool is made of wood, it shall withstand 246,100 volts per meter (75,000 volts per foot) of length for 3 minutes, or

(iii) The tool shall withstand other tests that the employer can demonstrate are equivalent.

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