

MIFACE INVESTIGATION REPORT: #09MI082

Subject: Golf Course Mechanic Died When Struck by Falling Ash Tree

Summary

In the fall of 2009, a 53-year-old male golf course mechanic was struck by an 84-foot tall, 15-inch diameter dead ash tree he was felling.

The decedent and his coworker were in the process of removing eight dead ash trees on the course. The incident ash tree was assessed and damage noted approximately 36 feet above the ground. Additionally, one of the ash tree's limbs was



Figure 1. Overview of incident scene, facing north

wedged in an adjacent tree to the north. The desired fall path was to the south. To fell the tree, the decedent made a 6¾-inch Humboldt-style notch on the south side of the tree approximately 32 inches from the base of the stump. The decedent made a downward diagonal back cut, at an approximate 45-degree angle and in approximately 6½ inches, into the north side of the tree. The decedent had retreated 24 feet to the west between a stand of trees after making his cuts. At some point in the process, the decedent made a horizontal cut from the south side of the tree into the existing hinge wood leaving approximately ¼-inch of hinge wood remaining. When the tree did not fall, the decedent returned to the tree to make further cuts and the tree began to fall. The decedent then retreated to the north. Instead of falling to the south, the tree began to fall to the north, in the direction of the decedent's retreat. The tree in which the ash limb was wedged apparently placed excessive pressure on the ash tree's damaged area causing the ash tree to snap at approximately the 35 foot mark. The top 48 feet of the ash tree fell at an east/west axis and the base of the tree fell to the north. The decedent had retreated approximately 27 feet from the ash tree when he was struck in the back by the falling tree. The decedent's coworker contacted emergency response. Emergency response arrived and transported the decedent to a local hospital where he was declared dead.

RECOMMENDATIONS

- Employers should ensure workers have appropriate training prior to beginning work and not assume that a worker who has relevant past experience performing a task has an appropriate level of expertise to perform the task.

- Employers who have employees conduct tree trimming and removal operations should ensure a job briefing is performed by a qualified individual/arborist prior to any tree removal operation.
- Employers should conduct a hazard assessment to determine if job tasks require the use personal protective equipment (PPE). If PPE is required, employers should perform the required employee training and develop procedures to ensure its use.
- Employers should develop a written safety and health program that includes employee education and training and that reflects the composition of the business. In this incident, the employer should develop a safety and health program for the kitchen, the restaurant/banquet center, the golf course operation/maintenance group, etc.
- MIOSHA should update General Industry Safety Standard, Part 53, Tree Trimming and Removal to include applicable requirements from MIOSHA Standard Part 51, Logging to address tree removal safety issues and reference the most recent Z133 Committee consensus standard for safety practices for arborists.

INTRODUCTION

MIFACE investigators were informed of this work-related fatality by the Michigan Occupational Safety and Health Administration (MIOSHA) personnel, who had received a report on their 24-hour-a-day hotline. The MIFACE researcher interviewed the decedent's employer at the golf course in November, 2009. The employer escorted the MIFACE researcher to the incident scene and permitted pictures to be taken. During the course of writing this report, MIFACE reviewed the MIOSHA compliance file, police report and pictures, the death certificate and medical examiner's report. Pictures used in this report are courtesy of the responding police department, MIOSHA compliance officer and pictures taken by the MIFACE investigator at the time of the site visit.

The 190 acre, 27-hole, public golf course had been in business for approximately 20 years. The course was separated into three 9-hole courses. The property also included a driving range and a restaurant and banquet center. The number of employees depended upon the season and activities. Peak employment occurred in the summer (as many as 105 employees) and fewer employees (as few as 10) in the winter. The course had no lost time injuries for the past 7 years. One individual sustained a cut in the restaurant kitchen in 2008. This injury was treated as first aid.

The decedent had been employed by the golf course for approximately 20 years. The employer indicated that the decedent had previously worked for another business felling and trimming trees. The employer indicated that the decedent "had been trained by the fact that he had 20 years of experience."

The employer had a training program, but did not have a training program related to felling trees. The employer indicated that the golf course's assistant superintendent had attended a golf course management class that included a tree removal segment. The course also included hands-on practice with a chain saw and tree felling. The employer indicated that golf course employees had felled trees since the inception of the business, but if a tree that needed to be cut down posed

a safety or property issue, for example, felling a tree near a bridge path, an outside firm was hired to perform the work.

Safety meetings were held by management at the beginning of the summer season and as necessary throughout the year. The course had an employee manual that covered general safety topics. The course's insurance company provided some safety training materials.

Employer Remediation

The employer developed a directive to the golf course Maintenance Department regarding Tree Cutting indicating procedures which shall be followed at all times when cutting down trees, citing MIOSHA General Industry Safety Division Tree Trimming and Removal Standard, Part 33 (Rule 3308 (1), 3312 (1)) and Part 53 (Rule 5336 (1-8), Rule 5311 (a), Rule 5336 (9), and Rule 5313 (2)).

The employer also mandated the use of a professional tree service to cut trees until employees assigned to cutting trees were appropriately trained by outside third parties who perform such training.

MIOSHA Citations

MIOSHA General Industry Safety Division issued the following Serious citations at the conclusion of its investigation:

TREE TRIMMING AND REMOVAL, PART 53

- RULE 5336(1) - Before a cut is started, a feller shall check for other employees and dead limbs, angle of tree, wind condition, location of other tree and other hazards, and plan his path of retreat:

Inadequate plan for path of retreat, employee was struck by manually felled tree that was damaged and involved other trees.

- RULE 5336(3) - Require large enough undercut (about 1/3 tree diameter):

Inadequate undercuts in that the cuts performed were excessive, surpassing 1/3 diameter of the tree being felled.

- RULE 5336(4) - Leave sufficient back cut hinge wood (about 2 inches):

Inadequate back cuts in that the cuts performed were excessive, leaving inadequate hinge wood to direct the tree being felled.

- RULE 5311(a) - An employer shall provide training to each new employee regarding the requirements of this standard, the job hazards and safeguards before starting his assigned job:

No training provided for employees.

- RULE 5311(a) - An employer shall conduct a job briefing before any tree job involving unusual hazards is begun:

No job briefing conducted, employees removing trees that are dead, damaged, and/or intermingled by other trees.

- RULE 5336(9) - If there is danger of a tree falling the wrong way, such means as wedges, block and tackle, or rope shall be used to control the fall:

No means were used to control the fall of a damaged and dead tree that was aurally interfered by nearby live tree.

- RULE 5336(5) - Clear area before starting back cut:

Area not cleared before back cut started in that second employee in area with tractor.

- RULE 5313(2) - Required use of head protection:

No head protection used for manual tree felling.

PERSONAL PROTECTIVE EQUIPMENT, PART 33

- RULE 3308(1) - There was no assessment of the workplace to determine if hazards that necessitated the use of personal protective equipment were present, or were likely to be present:

No assessment, chain saw and manual tree felling.

- RULE 3312(1) - Each affected employee did not use appropriate eye and/or face protection as prescribed in rule 3311 of Part 33 where a hazard existed due to flying objects or particles, harmful contacts, exposures, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, glare, injurious radiation, or electrical flash:

No eye protection was used by employee felling trees with chain saw.

INVESTIGATION

Over the past several years, emerald ash borer damage resulted in a large die off of trees on the golf course; the course personnel had felled and removed nearly 500 trees. The ash trees being felled on the day of the incident were also killed as a result of the emerald ash borer.

The decedent and his coworker, the golf course superintendent, were in the process of removing dead ash trees from a stand of trees on the course. The area was partially wooded and a creek was located to the east of the incident site. The superintendent was the driver of a Ford Tractor 555B which was used to push the trees over after the decedent had made the tree undercuts and

back cuts with a Stihl chain saw. The decedent was wearing boots and gloves; no hard hat, safety glasses or goggles, chaps, hearing protection, etc.

Several trees had been felled prior to the ash tree involved in the incident. Each tree had a Humboldt-style notch. A Humboldt notch is a directional felling technique. The cut is made into the side of a tree facing the intended direction of fall and consists of a horizontal face cut and an angled cut below it, creating a notch opening face of roughly 45 degrees. MIOSHA Tree Trimming and Removal Standard, Part 53 requires that the notch depth should be approximately $1/3^{\text{rd}}$ of the tree diameter. Consensus standards indicated that hinge thickness (holding wood) should be approximately $1/10^{\text{th}}$ of the tree diameter. Each of the previously cut trees did not have a proper notch or back cut that left insufficient hinge wood. A short description of each tree and its felling technique is described below:

- Tree 1 had a diameter of approximately 12 inches. The notch was 7 inches horizontally and the back cut was approximately $4\frac{1}{2}$ inches into the tree leaving approximately $\frac{1}{2}$ -inch of hinge wood.
- Tree 2 had a diameter of approximately 15 inches. The notch was approximately 7 inches horizontally. The back cut was on a diagonal approximately 3 inches above the notch apex leaving approximately $\frac{1}{2}$ -inch of hinge wood.
- Tree 3 was approximately 10 inches in diameter. The notch was approximately 7 inches horizontally. The back cut was diagonal, and down to and below the notch apex leaving virtually no hinge wood. The notch apex is defined as where the two cuts meet – it should be more or less level.
- Tree 4 was approximately $17\frac{1}{2}$ inches in diameter. The notch was approximately $10\frac{1}{2}$ inches horizontally. The back cut was approximately $1\frac{1}{2}$ inches below the notch apex and left approximately $\frac{3}{4}$ - inch of hinge wood.

The 84-foot tall ash tree involved in the incident was approximately 13 to 15 inches in diameter. The tree had existing damage approximately 36 feet above ground level. One of its limbs was wedged in an adjacent tree to the north (Figure 2).

The decedent's coworker was in the Ford tractor parked approximately 30 yards north of the tree being felled. The decedent made a Humboldt style notch cut of $6\frac{3}{4}$ inches horizontally on the south side of the trunk at approximately 32 inches from the base of the stump. The decedent then executed the back cut down diagonally at an approximate 45 degree angle to approximately $6\frac{1}{2}$ inches into the tree from the north leaving approximately 0.5 inches of hinge wood (Figure 3).

The decedent retreated to a point west of the tree approximately 24 feet away between some standing trees as the tree began to fall to the south (its



Figure 2. Tree in which incident tree limb was wedged.

desired path). The area where he retreated to is identified in Figure 4 as the stand of trees where the golf cart is located. The tree stopped falling. The decedent returned to the tree and made an additional horizontal cut from the south into the existing hinge wood leaving approximately 1/4-inch of hinge wood.



Figure 3. Felling technique of incident tree



Figure 4. Golf cart shows location of decedent's first retreat into stand of trees

The decedent retreated to the north as the tree began to fall. Apparent interference from the adjacent tree to the north in which the falling tree's limb was lodged resulted in the ash tree

snapping at approximately the 35-foot mark. The top 48 feet of the tree fell in an east/west direction toward the creek and the remaining base of the tree fell to the north (Figure 5). The coworker indicated to the responding police department that the decedent realized that the tree was falling towards him and he began to run.

As the decedent was running to the north, the tree struck him from behind in the middle of the back between the shoulder blades; he was approximately 24 feet away from the tree stump when the tree struck him. The decedent's coworker ran from the back hoe to the decedent and found him not breathing. The coworker called for emergency response. The chain saw was found next to the decedent. The decedent was transported to a local hospital where he was declared dead.

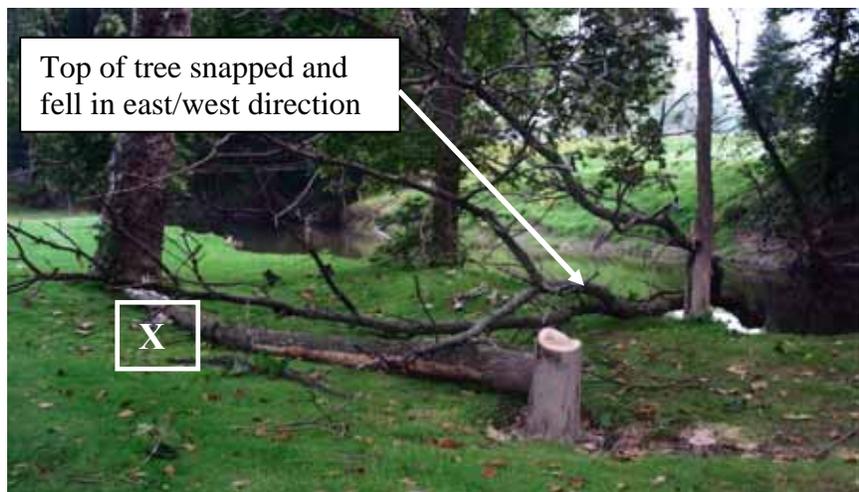


Figure 5. Incident scene. Decedent location indicated by X.

CAUSE OF DEATH

The cause of death as listed on the death certificate was cervical and thoracic spine fractures with injuries to the spinal cord due to blunt impact of the torso. Toxicology was negative for illegal drugs and alcohol.

RECOMMENDATIONS/DISCUSSION

- Employers should ensure workers have appropriate training prior to beginning work and not assume that a worker who has relevant past experience performing a task has an appropriate level of expertise to perform the task.

The decedent's employer made the assumption based on the decedent's past work experience that he was familiar with and practiced safe felling techniques. The decedent's work practices, such as wearing appropriate personal protective equipment, and felling techniques did not adhere to consensus or regulatory standards for tree removal.

The decedent did not adhere to consensus or regulatory requirements when making his Humboldt-style notch and back cut. The proper notch and back cut directs the tree's fall and the hinge wood (holding wood) keeps the tree under control and in its directed fall path.

Generally, regarding notch, back cut, and hinge wood, consensus/regulatory standards require:

- Hinge thickness approximately 1/10th the tree diameter
- Hinge width, at a minimum, 80% of the tree diameter
- Notch depth not be greater than 1/3rd the trunk diameter
- Notch width at least 80% of trunk diameter
- Notch apex (where the two cuts meet) as level as possible
- Widest part of notch face should point in the direction of the fall (notch apex at right angles to intended fall direction).
- If Humboldt notch is utilized, the back cut must be made 1-2 inches higher than the horizontal apex of the notch.

The employer had not conducted training in the requirements of Part 53. For example, it appears the decedent's coworker (the golf course superintendent) was unaware of what constituted a safe distance from a tree felling activity. MIOSHA Part 53, Rule 5336(2) states "Each assisting employee on the ground shall be instructed exactly what he is to do. Other employees shall be cleared to a distance of twice the height of the tree being cut." The decedent's coworker placed himself in danger of injury/death by positioning himself too close to the felling activity - he was approximately 30 yards away from the 84-foot tall ash tree and in line with its unexpected fall direction.

Employers should provide specific training and/or ensure an experienced worker with a stated expertise appropriately demonstrates competency in the area of stated expertise. Employers should ensure that training and/or demonstration documentation is kept on file.

Employers may find it helpful to utilize the American National Standard Institute's (ANSI) Standard for Arboricultural Operations – Safety Requirements (Z133.1-2006). Annex B contains recommended guidelines for standard performance and safety training for qualified arborists/qualified arborist trainees. This Annex (identified as Informative) provides for employee orientation to include:

- Job description appropriate to job assignment
- Introduction to immediate supervisor and crew members
- Familiarization with appropriate personal protective clothing and equipment and 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 acknowledgement by employee that he/she had participated in such training.

The Annex also discusses general safety items, such as OSHA and ANSI standards, public safety and traffic control, electrical hazards, emergency conditions and job site briefings.

- Employers who have employees conduct tree trimming and removal operations should ensure a job briefing is performed by a qualified individual/arborist prior to any tree removal operation.

MIOSHA General Industry Standard Part 53, Tree Trimming and Removal requires an employer to “provide training to each new employee regarding the requirements of this standard, the job hazards and safeguards before starting his assigned job. A job briefing shall be conducted *before any tree job involving unusual hazards is begun.*” (*italics added*) The dead ash tree had been noted to have damage approximately 26 feet above ground. Additionally, one of the tree's limbs was wedged within the structure of a nearby tree, posing a hazard for felling the tree.

The ANSI Standard, for Arboricultural Operations – Safety Requirements (Z133.1-2006) is a consensus standard and has a broader requirement for pre-job briefings. The Standard requires that “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.”

Z133.1-2006 defines a job briefing as “the communication of at least the following subjects for arboricultural operations: the hazards associated with the job, work procedures involved, special precautions, electrical hazards, job assignments and personal protective equipment.” A qualified arborist is defined as “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.*” (*italics added*)”

The golf course permitted staff to perform tree trimming and removal operations. MIFACE encourages firms that have staff perform tree trimming and removal operations to have a

qualified arborist oversee field operations and ensure job briefings are performed prior to such activities.

In this incident, a job briefing had not been conducted before the tree's removal. Additionally, employee training required under MIOSHA Part 53 had not been performed. If a job briefing by a qualified arborist had been performed, the unusual hazards of the tree damage a wedged tree limb, and the possibility of the tree falling in an unexpected direction due to the placement of the tree limb may have been recognized and a different approach to felling the tree may have been taken.

- Employers should conduct a hazard assessment to determine if job tasks require the use personal protective equipment (PPE). If PPE is required, employers should perform the required employee training and develop mechanisms to ensure its use.

MIOSHA General Industry Safety Standard, Part 33, Personal Protective Equipment requires an employer to assess the workplace to determine if hazards that necessitate the use of personal protective equipment (PPE) are present or are likely to be present. If hazards are present or are likely to be present, then the employer shall perform the following:

- (a) Select and have each affected employee use the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment,
- (b) Communicate selection decisions to each affected employee, and
- (c) Select the PPE that properly fits each affected employee.
- (d) Verify that the workplace hazard assessment has been performed through a written certification which identifies the document as a certification of hazard assessment and which specifies all of the following information:
 - a. The workplace evaluated
 - b. The person who certified that the evaluation has been performed
 - c. The date of the hazard assessment

Additionally, Part 33 requires training for individuals who are required to wear the designated PPE. Training for affected employees must include:

- When PPE is necessary
- What PPE is necessary
- How to properly don, doff, adjust and wear the PPE
- The limitations of the PPE and
- The useful life of the equipment and its proper care, maintenance, and disposal.

Employees must demonstrate to the employer that they have an understanding of the training received and the ability to use the PPE properly before being allowed to perform the work requiring its use. Employers must document that the employee has received and understood this training. The MIOSHA Tree Trimming and Removal Safety Standard requires an individual to use eye protection and head protection when conducting tree trimming/removal activities.

Additionally, MIFACE recommends employees using a chain saw wear hearing protection, as the sound level of a chain saw can reach 110 decibels (dBA). MIOSHA Occupational Health Standard, Part 380, Occupational Noise Exposure limits the amount of time an employee may be

exposed to sound levels above 90 dBA; at 90 dBA, eight hours is the maximum time an individual may be exposed. Part 380 also requires employers to implement feasible engineering and administrative controls if the sound levels exceed 90 dBA for an 8-hour exposure. If the controls do not reduce sound levels to within the levels specified in the standard, PPE must be provided and used to reduce employee noise exposure to within the specified levels. At 110 dBA, the standard permits only a 30-minute exposure – after 30 minutes, engineering/administrative/PPE controls must be used to reduce the employee’s exposure.

- Employers should develop a written safety and health program that includes employee education and training and that reflects the composition of the business. In this incident, the employer should develop a safety and health program for the kitchen, the restaurant/banquet center, the golf course operation/maintenance group, etc.

Due to the varied types of work performed at this golf course, MIFACE encourages the employer to develop a general, written health and safety plan for the operation and, in addition, a specific health and safety plan for each business operation. A kitchen operation has different safety and health hazards compared as to the golf course operations. The employer should train applicable individuals on the aspects of overall golf course health and safety plan and the business operation-specific health and safety plan.

- MIOSHA should update General Industry Safety Standard, Part 53, Tree Trimming and Removal to include applicable requirements from MIOSHA Standard Part 51, Logging to address tree removal safety issues and reference the most recent Z133 ASC Committee consensus standard for safety practices for arborists.

Due to the number of trees damaged by the emerald ash borer, non-tree-removal businesses may be performing an increased level of tree removal work. The MIOSHA Part 51, Logging Standard addresses many of the types, circumstances, and hazards associated with tree removal, such as isolated workplaces, employee protection in certain weather conditions, increased use of machinery, such as cranes used in removing tops of trees and aerial lifts to delimb, personal protective equipment for chain saw and wire rope use, etc. Many workers in the tree removal business have work activities and environments that mimic those in encountered in a logging activity, but the standard does not directly address them, nor provide employer guidance on many of these issues.

For example, the Logging Standard - Part 51, Rule 5151(2) states: “Before a cut is started, a feller shall check for the location of all of the following and plan and clear a path of retreat:

- (a) Other employees
- (b) Dead limbs
- (c) Lean of the tree
- (d) Wind condition
- (e) Location of other trees and other hazards
- (f) Snow and ice accumulation”

Part 51, Rule 5151(3) states:”The retreat path shall extend diagonally away from the expected felling line, unless the employer demonstrates that such a retreat poses a greater hazard than an

alternate retreat path. Once the back cut has been made, the feller shall immediately move a safe distance away on the retreat path and away from the tree being felled.”

Tree Trimming, Part 53, Rule 5336(1) identifies the same issues as Part 51, Rule 5151(2): Before a cut is started, a feller shall check for other employees and dead limbs, angle of tree, wind condition, location of other trees and other hazards and plan his path of retreat.” No language in Part 53 addresses how to plan for a path of retreat, yet arborists and tree trimmers are exposed to the same danger. This is one example of the more comprehensive requirements for tree felling identified in the language in Part 51, Rule 5151 (2) and (3) than in Part 53, Rule 5336(1).

Another example of Part 51 addressing the same risk posed by individuals not performing “logging” work but “tree removal” work is a danger tree or a lodged tree. A danger tree is defined in Part 51 as “a standing tree that presents a hazard to an employee due to conditions such as deterioration or physical damage to the root system, trunk, stem, or limbs and the direction and lean of the tree.” A lodged tree is a “tree that is prevented by another tree from falling to the ground.” Both types of danger trees are routinely encountered by arborists (tree workers) but are not addressed in Part 51, Tree Trimming and Removal except in Rule 5333(2), Limbing, stating: “Branches bent under tension shall be considered hazardous and the situation corrected.” The tree the decedent was felling with the chain saw met both of the definitions of a danger tree and a lodged tree – the tree was dead and had dead overhead branches and hanging layers of dead bark, damage 36 feet above ground, and a wedged limb in an adjacent tree. Part 51 specifically addresses danger trees in Rule 5151(7) and (8), Rule 5154, and lodged trees in rule 5153.

Additionally, ANSI Z133.1-2006, American National Standard for Arboricultural Operations – Safety Requirements, significantly revised its Z133.1-2000 American National Standard for Arboricultural Operations – Pruning, Repairing, Maintaining and Removing Trees and Cutting Brush – Safety Requirements. The standard identifies best practices, including notch and back cut requirements, and addresses issues such as general safety requirements, electrical hazards, safe use of vehicles and mobile equipment used in arboriculture (such as aerial devices, brush chippers, log loaders, cranes and related hoists), portable power hand tools, hand tools and ladders, and work procedures (such as ropes and climbing equipment, pruning and trimming, cabling, rigging, tree removal, brush removal and chipping, limbing and bucking, and pesticide application). The standard also has non mandatory (informative) annexes.

Additionally, ANSI Z133.1-2006 identifies requirements to plan an escape route. Section 8.5, Tree Removal, subsection 8.1.4: “A planned escape route for all workers shall be prepared before cutting any standing tree or trunk. The preferred escape route is 45 degrees on either side of a line drawn opposite the intended direction of the fall. Obstructions shall be cleared along the escape path. The chain saw operator shall use this path for egress once the cut has been completed.” This guidance would be useful for non-arborist employers consulting the MIOSHA standards.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (LARA) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Licensing and Regulatory Affairs, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

- MIOSHA General Industry Safety Standard, Part 53, Tree Trimming and Removal
- MIOSHA General Industry Safety Standard, Part 51, Logging
- MIOSHA General Industry Safety Standard, Part 33, Personal Protective Equipment
- MIOSHA Occupational Health Standard, Part 380, Occupational Noise Exposure
- MIOSHA Tree Trimming Initiative. http://www.michigan.gov/lara/0,1607,7-154-11407_30928-153319--,00.html
- ANSI Z133.1-2006, American National Standard for Arboricultural Operations – Safety Requirements
- National Arborist Association Pocket Guide – Safe Tree Felling
- State of Washington FACE Report #52-2-1999: Tree Faller Struck by Tree. <http://www.lni.wa.gov/Safety/Research/FACE/files/logger.pdf>

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