MIFACE INVESTIGATION REPORT: #07MI072

Subject: Laborer Killed After Being Run Over by the Tractor and Mower He was Operating

Summary

On June 13, 2007, a 45-year-old male laborer was killed when he was run over by both the John Deere 5410 riding tractor and a Woods 3180, 15-foot wide brush hog type mower he was operating (Figure 1). The decedent was driving the tractor/mower in a circular motion to cut two- to three-foot high grass in a park. The ground was uneven, with a rut depth ranging from one inch to a maximum of six inches. The decedent either exited the tractor or fell from the tractor seat and was run over by both the tractor and the mower deck. Another employee entered the park at 1:30 p.m. looking for the decedent and found the decedent's tractor stopped against a stump. The tractor was still running, its tires were spinning, and the power take off for the mower was engaged and running. The employee found the decedent's body lying on the ground 10 to 15 feet from the tractor. This employee called 911 and then called the maintenance yard to which they were assigned. Emergency response arrived and the decedent was declared dead at the scene.

Figure 1. Tractor and mower involved in the incident

RECOMMENDATIONS

- Employers should establish a seat belt or seatbelt/shoulder harness restraint policy (when equipment is so equipped), include the seatbelt requirement in their safety manual and safety training programs, and enforce its use.
- Employers should review older equipment safety features to determine if safety upgrades could be installed.
- Employers should establish procedures for communicating with employees working alone.
- Employers should establish a joint health and safety committee.
- Employers should develop topographical park layouts showing potential hazardous locations and employees should review these layouts at the time of assignment. Updates to these diagrams should be made as the mowing season progresses.
- Employers should maintain equipment in proper working condition in accordance with the manufacturer's guidelines and document such maintenance.

- Employers should ensure employees are trained and follow safe operating procedures for riding equipment, including equipment start-up and shutdown procedures.
- Employers should train employees about required personal protective equipment and ensure that it is worn.
- Employers should develop a fleet safety program specific to the vehicles driven on the road by employees.
- Employers should develop, implement and enforce training for affected employees about the hazards of heat stress, heat strain and heat-related illnesses.
- Workers who take medications or who have medical conditions that would predispose them to heat-related illnesses should be evaluated by a health care provider on their fitness to work in a hot environment.
- Employers should ensure that riding equipment over 20HP is equipped with a certified operator protection system (such as ROPS/seatbelt).

INTRODUCTION

On June 13, 2007, a 45-year-old male laborer was killed when he was run over by both the John Deere 5410 riding tractor and a Woods 3180, 15-foot wide brush hog type mower he was operating. On the same day as the fatal incident, MIFACE investigators were informed by the Michigan Occupational Safety and Health Administration (MIOSHA) personnel, who had received a report on their 24-hour-a-day hotline that this work-related fatal injury had occurred. On October 15, 2007, MIFACE interviewed the health and safety officer for city department for whom the decedent worked, the decedent's supervisor and his coworkers. Coworkers provided a brief tour of the department's equipment storage building, which included an overview of a tractor and mower that were similar to the equipment the decedent was operating at the time of the incident. During the course of writing this report, the police report, medical examiner report, and the MIOSHA file and citation were reviewed. The pictures used in all of the figures are courtesy of the MIOSHA compliance officer.

The city department provided general city services, such as but not limited to grounds maintenance, property management, buildings operation/maintenance, etc. The city department employed approximately 500 individuals. The decedent was one of 35 individuals assigned to a specific maintenance yard. He was one of eight vehicle operators at the site. The decedent was a full-time, hourly seasonal laborer, who worked from April 1 to October 1. He had four years of seasonal work experience in other city departments. This was his first rotation in this department. His work hours were 6:00 a.m. to 2:30 p.m. His job title was a vehicle operator, and he was a member of the union.

The decedent had a valid commercial drivers license (CDL). The decedent's initial job with the city was as a driver who brought laborers and equipment to the job site and to drive trucks/trailers, tractors and refuse packers. If the work crew were short-handed, the decedent would operate equipment. The decedent had worked for another company where he used tractors, thus he had six to seven years experience operating tractors.

Each city department had its own safety officer. The safety officer for this department reported directly to the department director. The city, and thus the department, had a written health and safety program. There were written safety rules and procedures in place for operating the tractor. Neither the city nor the department had a health and safety committee.

The department's safety officer usually conducted the training and orientation for the city department employees assigned to the garage. The safety officer was not available to provide the required training for the decedent, so another tractor operator with one year of experience performed the training. The operator showed the decedent basic tractor operation techniques, which included having the decedent watch the operator cut a small park. This one-day training session occurred in early June 2007 prior to the decedent being allowed to operate the tractor/mower independently. The trainer observed the decedent operate the tractor and informed management that the decedent "was doing okay." The trainer did not document the training.

After the incident, the city department took several actions to address identified safety concerns. These actions included:

- Re-issued several directives for tractors, refuse packers, and lawn mowers. One of the directives was the requirement for all department employees who operate department vehicles to wear a seat (safety) belt while operating department vehicles on public streets, highways, and greenways.
- Standardized equipment training procedures. The operators must now pass a written and practical skills test for equipment they operate.
- Enforcement of equipment maintenance protocols.

MIOSHA General Industry Safety and Health division issued one Serious citation to the employer, citing Tractors, Part 22, Rule 2252(1). Rule 2252(1) states that an employee operating a tractor equipped with a roll over protection structure (ROPS) shall be required to wear a seat belt when the tractor is moving on a slope or under other conditions that affect its stability. The seat belt shall be adjusted so that it secures the operator to the seat.

INVESTIGATION

The tractor being operated was a John Deere 5410 tractor that weighed 5600 pounds. The tractor cab had a ROPS, operational seatbelt, and satisfactorily labeled hydraulic controls. The tractor cab was open: i.e., did not have a door. The ROPS-equipped tractor did not have a safety switch for the seat, which would have automatically stopped the tractor when the operator's weight on the seat was lifted. The tractor was towing a Woods 3180 brush hog type mower, referred to as a "bat-wing" mower. The mower had a 15-foot cutting deck. The equipment manual was not in the tractor cab but was present in the storage yard. The tractor had three categories of speed: A (slow), B (4 cutting speeds), and C (road travel speed). The tractor horsepower (65HP) and power take off (PTO) rated at 540 rpm met the operational requirements of the Woods 3180 (50-200 hp tractors with 540 or 1000 rpm PTO speeds).

When the decedent arrived at work at the maintenance yard garage at 6:00 a.m., the decedent received his work assignments for the day from his supervisor. The supervisor assigned him to cut the grass in a park located approximately three miles away. It was routine to have two workers sent to each park to cut. Only the decedent was sent because only one tractor was available.

The decedent was expected to perform a pre-trip inspection and complete a checklist. He did not turn in a completed checklist. The city department required that the tractor's operator wear the seat belt and use goggles and earplugs during tractor operation.

The decedent had not previously cut the grass in this park. He had operated the tractor/mower unit at least four times previously, mowing other venues. This was his first cutting job of the day. He drove to the park in the tractor after receiving the work assignment. The morning temperature as he was driving to the park was approximately 65 degrees F with clear, sunny skies. The decedent's clothing layers consisted of a tee shirt, boxers, sweatpants, work shirt and pants, coveralls, work boots and gloves. The decedent weighed less than 110 pounds.

Figure 2. Sideways movement of battery

After the decedent arrived at the park, it appeared he placed the mower at a B-3 cutting speed and mowed a swath of two- to three-foot grass as he approached the cutting area. The ground was rutted and uneven. The ground that he was cutting had five- to six-inch ruts and large dips in the terrain. The decedent's pattern of cutting the park was unclear. Coworkers stated that he had been cutting back and forth in a north/south direction. The MIOSHA compliance officer indicated that he had been cutting the grass in a circular motion.

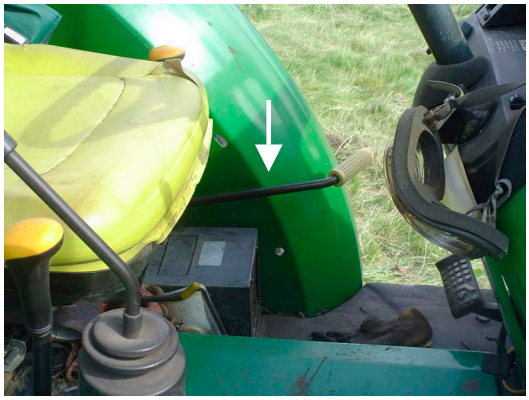

Figure 3. PTO lever engaged for mower blades to turn

By noon, the temperature had risen to 87 degrees F with 33% humidity. The decedent's coworkers stated he had eaten his lunch. At some point, the decedent was outside of the cab, either deliberately or unintentionally. It is unknown whether the decedent was standing on the ground next to the running tractor when it began moving forward or whether he fell from the operator's seat for some reason. A theory put forth by his coworkers was that the decedent may have fallen asleep or was affected by heat and lost consciousness in the tractor cab. The tractor wheel may have hit one of the rutted areas or another obstruction, causing the decedent to fall from the seat and be run over by the tractor and mower.

After the decedent fell from the tractor seat, the tractor continued to travel in a circular motion and eventually was stopped by a tree stump over one foot in height. When the stump brought the tractor's right front wheel to a halt, the tractor battery shifted and was knocked sideways inside of the front end of the tractor (Figure 2). There were divots five feet in front of where the tractor came to a dead stop and more divots in the ground due to the circular motion of the tractor/mower.

A coworker entered the park at approximately 1:30 p.m. and looked for the decedent. The coworker found the decedent's tractor running, the tires were spinning, and the power take off (PTO) for the bat wing engaged for the mower's cutter blades to turn (Figure 3). Not seeing the decedent in the cab or nearby, his coworker looked for him. He found him lying face down on the ground approximately 10 to15 feet from the tractor. The decedent was not wearing goggles or earplugs as required by city policy. The coworker called 911, and then called the maintenance yard to which they were assigned.

If the decedent was on the tractor seat and fell from the seat, he obviously was not wearing the tractor's seat belt. The responding police indicated that the employee was thrown from the tractor cab and was run over.

While at the incident scene, the MIOSHA compliance officer found that one of the locking pins, used to lock a side of the mower wing in a raised position, was bent and could not be used (Figure 4).

Figure 4. Bent mower locking pin

His coworkers stated that it could get hot inside of the tractor cab, not only due to outside temperature, but also due to the location of the engine under the tractor operator's seat. His coworkers also stated that the decedent had health conditions, which made him sensitive to sunlight and heat. According to his coworkers, the decedent had brought this issue to the attention of his supervisor. MIFACE did not interview the decedent's supervisor. He was working in a different district and MIFACE was unable to make contact with him during the interview process.

At the time of the incident, the workers did not have city-supplied, serviceable, 2-way radios. The employees were using their personal cell phones to communicate with the maintenance. These radios have been repaired and are currently in service.

CAUSE OF DEATH

The cause of death as stated on the death certificate was multiple injuries. Toxicology was negative for alcohol and illicit drugs.

RECOMMENDATIONS/DISCUSSION

- Employers should establish a seat belt or seatbelt/shoulder harness restraint policy (when equipment is so equipped), include the seat belt requirement in their safety manual and safety training programs, and enforce its use.

Rule 257.710e(3) of the Michigan Motor Vehicle Code requires that each driver and front seat passenger of a motor vehicle operated on a street or highway in this state shall wear a properly adjusted and fastened safety belt when the equipment is so equipped. The city department had established a seat belt policy, but it was not enforced.

Figure 5. Seatbelt available on the tractor

Many pieces of equipment used, such as forklifts, front-end loaders, and refuse packers, etc., are equipped with either a seat belt or a seatbelt/shoulder harness safety restraint system (Figure 5). Employers should require, regardless of on-road or off-road use, that employees use the safety restraint system supplied by the equipment manufacturer at all times while operating the equipment. Employers should ensure such restraints are in place and in good working condition.

The city department had a written statement regarding the required use of a seatbelt or seatbelt/shoulder harness for equipment equipped with such restraints. The health and safety program should also include a similar statement to reflect the management requirement for employees to wear the safety restraints provided by the manufacturer.

The city department, as part of their new standardized equipment training program, includes a segment on the use of safety belt/harness training that includes information about wearing lap and shoulder belts. The initial instruction should be a part of employee orientation and driver training and should include information about the importance of and reasons for using safety belts.

U.S. Department of Transportation, Federal Motor Carrier Safety Division (FMCSD) has in partnership with safety engineers, trucking companies, safety alliances and insurance companies developed a manual, *Increasing Safety Belt Use in Your Company*. Although the FMCSD manual is aimed at over the road trucking companies, many agricultural employers can benefit from the information contained in the manual. Topics include:

- Corporate Safety Belt Statement and Pledge
- What Drivers Need to Know About Safety Belt Use
- How to Create, Evaluate and Reinforce a Safety Belt Training Program
- Employee Knowledge Tests
- Two-Minute Safety Talks

- Employers should review older equipment's safety features to determine if safety upgrades could be installed.

As machine technology has progressed, so have the safety features installed on these machines. Many pieces of older equipment are not equipped with current safety features. The employer should survey their equipment to determine if additional safety features, such as a seat-activated safety interlock switch could be installed. The seat-activated safety interlock switch acts as an engine kill switch. The operator must be seated to permit equipment operation and movement. The switch should be installed in a manner that cannot be easily defeated by the workers.

- Employers should establish procedures for communicating with employees working alone.

A person can be considered alone at work when they are on their own; when they cannot be seen or heard by another person; and when they cannot expect a visit from another worker. It is important that a check-in procedure be in place. The employer should decide if a verbal check-in is adequate, or if the employee must be accounted for by a visual check. The employer should define under what circumstances the lone employee would check in and how often. A communication device, the employee's personal cell phone, was available to the employee to communicate with the yard concerning an equipment breakdown or malfunction, or to report an emergency situation to other individuals. There was no procedure developed for the employer to check in with employees working in remote areas to make work assignment changes or check on their well-being.

The Canadian. Centre for Occupational Health and Safety (CCOHS) has developed guidance for employers who have employees who work alone (http://www.ccohs.ca/oshanswers/hsprograms/workingalone.html). Another source of information for developing a working alone policy is the Worksafe Western Australia Commission: http://www.docep.wa.gov.au/WorkSafe/PDF/Guidance_notes/Guide_working_alone.pdf.

- Employers should develop a joint health and safety (H&S) committee.

An H&S committee, comprised of both management and other employees provides a forum for management and employees to regularly discuss health and safety issues in the workplace. An H&S committee is an important way for employees to help manage their own health and safety and assist the employer in providing a safer, healthier workplace. The formation of the H&S committee provides a process for open communication on health and safety issues and enhances the ability of employees and management to resolve safety and health concerns reasonably and cooperatively.

Much of the potential value of an H&S committee can be lost without careful development of the purpose, functions and activities. The H&S committee will function effectively only after the need for the committee is recognized and employees,

supervisors and managers welcome its services. At their worst, H&S committees can be a "negative-minded" group confining their approach primarily to (after-the-fact) placing of blame. However, at their best, they can become an effective tool to help prevent unsafe practices and conditions, reduce the risk of injury and illnesses and to help motivate employees and supervisors to become actively involved.

MIOSHA has several resources that can be accessed for development of an effective H&S committee. The Good Safety and Health Programs are Built with Good Safety Committees brochure details the advantages of having an effective Health and Safety Committee (www.michigan.gov/documents/cis_wsh_cet0140_103132_7.pdf). The MIOSHA Safety and Health Toolbox contain materials that focus on the major components of a health and safety system. Module 2 of the Toolbox focuses on employee involvement and contains several resources for Health and Safety Committee development (www.michigan.gov/cis/0,1607,7-154-11407_15317-124535--,00.html).

The State of Wisconsin "Guidelines for Developing an Effective Health and Safety Committee" (www.doa.state.wi.us/docs_view2.asp?docid=665) and the Canadian Centre for Occupational Health and Safety, Occupational Safety and Health Answers: Health and Safety Committees (www.ccohs.ca/oshanswers/hsprograms/hscommittees/) both provide valuable resources and a framework for selection of H&S Committee membership, purpose, function and activities.

- Employers should develop topographical park layouts showing potential hazardous locations and employees should review these layouts at the time of assignment. Updates to these diagrams should be made as the mowing season progresses.

The city had 70 parks, divided among four city quadrants that needed mowing attention during the course of the spring, summer and fall. Prior to the cutting season, the department should assign employees to develop a topographical diagram of potential hazards, such as ditches, stumps, overhead electrical lines, etc. and their location for each park. The diagram could also show equipment access points to the park, a mowing strategy, directions to the park site, etc. The decedent's coworkers indicated that this was his first time cutting this park. As this was an unfamiliar worksite, it may have been helpful for him to have a diagram showing approximate locations of potential hazards, such as the ruts and stumps. After diagram review, the decedent might have been more aware of the hazards inherent within this park and prepared differently.

As the mowing season progresses, terrain changes can occur, such as cutting trees, washouts, etc. the person noting the change(s) should update the park's layout. Supervision should then alert all affected workers of these conditions.

- Employers should maintain equipment in proper working condition in accordance with the manufacturer's guidelines and document such maintenance.

The decedent's coworkers stated that the tractor jumped out of gear after the incident. Depending upon how long after the incident this occurred, this could have been caused by the transmission being subjected to intense heat due to the tractor being in gear against the stump. The tractor did not have a maintenance service record. At the time of the incident, the department was not enforcing equipment maintenance protocols. The department has corrected this deficiency both by enforcement and conducting employee training.

- Employers should train employees about required personal protective equipment and ensure that it is worn.

The decedent was found not wearing the required personal protective equipment. The city department has developed additional personal protective equipment training, and this training is emphasized in the safety training program. To encourage individuals working alone to wear the required personal protective equipment, employers should have a responsible person such as a supervisor/manager periodically monitor these workers to assure compliance.

Supervisors have daily interactions with employees and should constantly encourage safety awareness. Workers can become complacent and develop a pattern of unsafe behavior that unless noted and addressed by management, becomes routine unsafe behavior. Workers' attitudes and motivations impact their work practices as well as their knowledge of how to do the work. Workers knowing the safe and correct way to work plus them knowing that the employer expects that the work will be conducted safely and correctly should be emphasized in worker training. Reinforcement of the importance of safe work procedures and the expectation that they would be followed is an important element in the prevention of injuries.

- Employers should develop a fleet safety program specific to the vehicles driven on the road by employees.

The city department operates many types of vehicles, including personal vehicles, on-the-road when staff traveled to and from work sites. Fleet safety programs can include qualification, training and supervision of drivers and employees; establishment of safe practices and rules; planned inspection and maintenance of vehicles; and report and review of accidents.

All of the sample fleet safety programs MIFACE reviewed on the Internet included a statement about following State traffic laws. The fleet safety program rules could easily be incorporated into the city department's safety program. A sample fleet safety program may be found at:
http://www.toolboxtopics.com/Beyond%20Safety%20Meetings/Fleet%20Stuff/Sample%20Fleet%20Safety%20Program.doc.

- Employers should develop, implement and enforce training for affected employees about the hazards of heat stress, heat strain and heat-related illnesses.

Much of the work performed by this department's employees was performed outside. The city had not provided heat stress training. Training should be conducted in early spring, because sudden changes in weather may result in dangerous heat strain levels. Because they may not have had time to become physically and psychologically acclimated to (adjusted to) the heat, workers should be aware of the hazards of working vigorously in hot conditions before they are exposed to hot conditions. Because acclimatization is one of the major factors in determining how well an individual is able to respond to heat stress, lack of acclimatization places workers at risk of heat-related illnesses during brief, unexpected periods of high heat.

It generally takes five days of working at least 1½ hours/day in a particular environment before the body becomes acclimated. Some acclimatization can be lost in as little as 3 to 4 days if the individual is exposed to a substantially different environment. To protect workers while developing acclimatization, the National Institute of Occupational Safety and Health (NIOSH) recommends new workers should be exposed to work in heat 20% on day 1 with a 20% increase each subsequent day. For workers who have had recent previous experience with the job, NIOSH recommends 50% exposure on day 1, 60% exposure on day 2, 80% on day 3 and 100% on day 4. Normal, healthy individuals can become gradually acclimatized to work in hot conditions in 5 to 10 days depending upon the degree of heat and humidity, their general health and their work schedule.

The American Conference of Governmental Industrial Hygienists (ACGIH) has published a work/rest regimen based upon a heat stress/strain assessment that "represents conditions under which it is believed that nearly all adequately hydrated, unmedicated, healthy workers may be repeatedly exposed without adverse health effects." The assessment is based upon a wet bulb, globe temperature (WBGT) index and general work demands. Air temperature, radiant heat, air movement, and humidity influence WGBT. Please see Appendix A for calculations of WBGT values and WBGT Screening Criteria for Heat Stress Exposure for Acclimatized Workers/Work-Rest Schedules.

Once the workers have been trained about heat stress, reinforcement is necessary to ensure that they do not become complacent nor forget what they have learned. Highly trained personnel receive retraining and practice at regular intervals to ensure they remain at the top of their skills. Reinforcement of the importance of watching for, recognizing, and knowing how to react to heat-related illnesses is an element of the training that should not be overlooked.

- Workers who take medications or who have medical conditions that would predispose them to heat-related illnesses should be evaluated by a health care provider on their fitness to work in a hot environment.

Ingestion of alcohol and medications can have an impact on a worker's heat tolerance. Workers who are taking medication or have certain underlying health conditions and their

supervisors/managers should be aware that some drugs and medical conditions exacerbate dehydration and increase the risk of heat-related illness. In general, young children, the very old, the infirm, and those in ill health are at greater risk of heat-related illnesses.

- Employers should ensure employees are trained to follow safe operating procedures for riding equipment, including equipment start up and shut down procedures.

It is unknown if the victim attempted to dismount while the tractor and PTO were running. A safe work practice is to shut off the tractor and PTO before dismounting. General shutdown procedures for a tractor are: disengage the PTO, lower equipment attachments to the ground, place the transmission into neutral or park, set the brakes, allow the engine to cool at a fast idle, turn off the engine and remove the key. The operator's seat of farm tractors and other machines provides a workstation from which the operator can maintain proper control of the machine. Proper control is necessary not only during operation of a tractor or machine, but also whenever an engine is started. While seated in the operator's seat, an operator should check the engine throttle position, disengage the clutch and shift the transmission into neutral or park before the engine is started. Setting the brakes will prevent the tractor from rolling before the operator engages the transmission. Before starting a tractor engine, the operator should also ensure the power take off is disengaged.

Performing these steps will reduce the likelihood of a tractor or machine accidentally moving forward or backward after the engine starts. In addition, if a tractor or machine does unexpectedly begin to move after starting, an operator seated in the seat will not be in danger of being run over and will be in position to maintain safe operating control.

Many modern tractor systems are equipped with additional safety interlock systems. Tractors equipped with neutral-start safety switches prevent the starter from cranking the engine if the transmission or clutch is engaged. When using an older model tractor without these safety interlock systems, one must be particularly careful to follow safe tractor starting procedures.

- Employers should ensure that riding equipment over 20HP is equipped with a certified operator protection system (such as ROPS/seatbelt).

The tractor involved in the incident met the requirements of federal and state law for operator restraint. Federal OSHA requires that agricultural tractors (CFR 1928.51(a)), or industrial tractors (CFR 1926.1002(j)(2)) of more than 20 engine horsepower be equipped with rollover protective structure (ROPS) to provide operator protection during a rollover or turnover event. MIOSHA General Industry Safety Standard, Part 22, Tractors also has the same engine horsepower/ROPS requirement. MIFACE recommends that employers conduct a survey of all riding equipment to determine if a certified operator protection system is required. If so, the equipment manufacturer should be contacted to determine if a ROPS/seatbelt retrofit is available.

The National Farm Medicine Center in Marshfield, MN maintains "A Guide to Agricultural Tractor Rollover Protective Structures" webpage listing of manufacturers, models, and approximate costs of obtaining a retrofit ROPS/seatbelt for a tractor.
The Rollover Protective Structures Guide can be found on the Internet at: http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nfmc_resources_rops_tract_roll.

REFERENCES

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

- MIOSHA General Industry Safety Standard, Part 22, Tractors.
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- Worksafe Western Australia Commission. Working Alone Guidance Note. Internet Address: http://www.docep.wa.gov.au/WorkSafe/PDF/Guidance_notes/Guide_working_alone.pdf
- MIFACE Investigation Report #02MI075: Landscape Mowing Assistant Dies From Heat Stroke. Internet Address: http://www.oem.msu.edu/MiFace/02MI075v1.pdf
- MIFACE Investigation Report #06MI135 Unrestrained Custom Spray Applicator Died When Ejected From a Self-Propelled Sprayer After Sprayer Struck an Oncoming Semi-Truck Trailer. Internet Address: http://www.oem.msu.edu/MiFace/MIFACE%20INVESTIGATION%2006MI135.pdf
- Woods: The Attachment Experts. Internet Address: http://www.woodsequipment.com/pressReleases.aspx?id=11623
- John Deere. Internet Address: http://www.deere.com/en_IN/home_page/ag_home/products/5410_65HP/5410_65hp.html
- National Farm Medicine Center in Marshfield, MN maintains "A Guide to Agricultural Tractor Rollover Protective Structures". Internet Address: http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nfmc_resources_rops_tract_roll.
- Ontario Ministry of Labor. Health and Safety Guideline. Heat Stress. http://www.labour.gov.on.ca/english/hs/guidelines/gl_heat.html

Key Words: Tractor, Struck By, City Park, Seat Belt, Heat Stress

Appendix A

The WBGT values are calculated using one of the following equations:
REF: 2008 ACGIH TLVs® and BEIs®, Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices.

With direct exposure to sunlight:
$WBGT_{out} = 0.7T_{nwb} + 0.2T_g + 0.1T_{db}$

Without direct exposure to the sun:
$WBGT_{in} = 0.7T_{nwb} + 0.3T_g$

where: T_{nwb} = natural wet bulb temperature (sometimes called NWB)
T_g = globe temperature (sometimes called GT)
T_{db} = dry bulb (air) temperature (sometimes called DB)

According to ACGIH, because WBGT is only an index of the environment, the screening criteria are adjusted for the contribution of work demands and clothing as well as state of acclimatization. The following table provides WBGT criteria suitable for screening purposes for workers in light summer clothing. For other than light summer work clothes, values must be adjusted.

WBGT Screening Criteria for Heat Stress Exposure for Acclimatized Workers REF: OSHA Technical Manual, Section III, Chapter 4, Heat Stress			
	Work Rates that are:		
	LIGHT	MODERATE	HEAVY
HOURLY ACTIVITY	^oF	^oF	^oF
100% Work (continuous)	86	80	77
75% Work & 25% Rest	87	82	78
50% Work & 50% Rest	88	85	82
25% Work & 75% Rest	90	88	86

MIFACE
Investigation Report #07 MI 072
Evaluation

To improve the quality of the MIFACE program and our investigation reports, we would like to ask you a few questions about this report:

Please rate the report using a scale of:	**Excellent**	**Good**	**Fair**	**Poor**
	1	2	3	4

What was your general impression of this MIFACE investigation report?

Excellent	**Good**	**Fair**	**Poor**
1	2	3	4

Was the report…	**Excellent**	**Good**	**Fair**	**Poor**
Objective?	1	2	3	4
Clearly written?	1	2	3	4
Useful?	1	2	3	4

Were the recommendations …	**Excellent**	**Good**	**Fair**	**Poor**
Clearly written?	1	2	3	4
Practical?	1	2	3	4
Useful?	1	2	3	4

How will you use this report? (Check all that apply)

- ❑ Distribute to employees
- ❑ Post on bulletin board
- ❑ Use in employee training
- ❑ File for future reference
- ❑ Will not use it
- ❑ Other (specify) _____

Thank You!

Please Return To:

MIFACE
Michigan State University
117 West Fee Hall
East Lansing, MI 48824
FAX: 517-432-3606

Comments:

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