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**Title:** ***An Audit of X Academy's Shop Eye Protection Program***

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**Stapleton, Kyle I.** ***An Audit of X Academy's Shop Eye Protection Program***

## Abstract

Hazards in a high school shop environment pose a very real threat to students as it relates to eye injuries. These dangers can be minimized through proper eye protection training as it relates to the Occupational Safety and Health Administration (OSHA) standard 1910.132(f) and the use of accurate signage which adheres to the American National Standards Institute (ANSI) standard Z535. The purpose of this study was to analyze X Academy's lab eye protection training and practices in relation to various business/industrial as well as regulatory-based standards. A literature review was performed to gather information to construct an assessment tool to audit X Academy's eye protection safety in regards to an eye protection policy, signage, training and the protection, care and storage of protective eyewear. The employed assessment tool indicated that X Academy's eye protection deficiencies were in the areas of student training, how to properly don and maintain eye protection, eye protection signage on shop-made tools and the lack of evidence of any written eye protection policy. Conclusions from this audit were that X Academy's students were at a greater risk of experience eye injuries due to the absence of a written eye protection policy, incomplete eye protection training and the lack of safety signage on shop-made tools.

**Acknowledgments**

I would like to whole heartedly thank my wife, children and parents for giving me the time and support to take on this endeavor. A special thanks is extended to Dr. Brian Finder, my research advisor, for going above and beyond helping me through this process.

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## Chapter I: Introduction

Safety is grouping of organized practices and/or design features in an operation where, if one part of the system is compromised, it may cause other parts to fail and thus lead to a catastrophic event which an injury could be the undesired end-result (Geller, 2012). Most existing safety materials stress the importance of utilizing basic personal protective equipment (PPE), such as safety glasses, but, in a high school shop setting, students' compliance with wearing this vital piece of safety equipment may be less than optimal (Welty, 2012). Considering the extent to which an individual uses his/her eyesight in order to perform daily tasks, it appears that the human species will always be in need of utilizing a certain form of eye protection in order to preserve this valuable sense (Welty, 2012).

The X Academy is located in Town X, Wisconsin, which is a small rural city located ten miles from the Minnesota border. The X Academy is an alternative charter high school that is designed to meet the needs of students who are seeking a high school diploma. Students benefit from innovative teaching and hands-on learning through individualized instruction, which is designed to fit various learning styles while incorporating a standard-based high school core curriculum. The X Academy's charter in based on the principle of "School to Work," which is intended to provide students the skills to succeed not only in higher education, but in the workplace as well. This alternative school runs a small business called "X Woodworking," which produces many products out of wood, plastic, and solid surface countertop materials.

In the past ten years of production, the students and staff have achieved a respectable safety record in terms of not experiencing any lost work-time accidents. However, it should be noted that several potentially costly incidents involving wood dust/chips in the students' eyes have occurred as a result of a failure to wear approved eye protection or wear such protective

equipment correctly. These incidents could have become costly if the individual would have lost his/her sight for an extended period of time. It is believed that the students at this alternative school are more than capable of learning and following directions, although there are certain individuals who may refuse to learn and/or follow instructor-provided directives as a means of taking control of an otherwise uncontrolled life style.

This form of non-conformant behavior seems to occur during the first part of every semester when it is the most difficult to impress upon the students the need to continuously wear protective eyewear whenever they are in the laboratory setting. Thus, an occasional lack of compliance with established eye protection requirements within the Technology Education Department Lab at X Academy is placing the associated students at significant risk of experiencing eye-related injuries.

**Purpose of the Study**

The purpose of this study was to analyze X Academy's lab eye protection training and practices in relation to various business/industrial as well as regulatory-based standards.

**Goals of the Study**

The goals of this study included:

1. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection use in a shop environment.
2. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection care/storage in a shop environment.
3. To identify any gaps in the shop safety signage in X Academy to use eye protection in a shop environment.

**Background and Significance**

Each day approximately 2,000 U.S. workers sustain job-related eye injuries which require a certain degree of medical treatment (Pieper, 2006). Approximately three-fifths of the 2,000 injured workers were not wearing eye protection or failed to wear the appropriate type of eye protection. It is estimated that ninety percent of occupationally-based eye injuries could be prevented with proper eye protection (Pieper, 2006). In 2003, an estimated 94,500 people received medical attention in emergency rooms due to industrial/home eye injuries (America, Workplace-Related Eye Injuries, 2010). Of those 94,500eye injury cases, approximately three percent or 30,437 people were injured with an object (hand/power tool, glue, nail, screws, and/or liquid varnishes) which are typically found in high school shop settings (America, 2010b).

The cost of an eye injury falls into the categories of direct and indirect costs. A direct cost would be the time that it takes to attend to the eye injuries, emergency response personnel fees (if needed), and rendered medical treatment. Indirect cost would include legal fees, a tarnished safety reputation that could lead to loss of business, closing of company, or higher insurance costs due to a reduction of the injured individual's life earnings and/or quality of living. Thus, it can be reasonably stated that eye injury prevention-related activities would be a worthy investment in relation to the significant cost of dealing with the accidents and subsequent loss of an individual's visual capabilities.

**Assumption of the Study**

It is assumed that X Academy is utilizing eye and face-related personal protective equipment (PPE) is appropriate for the various machine/process hazards which exist within a high school shop environment.

## Limitation of the Study

A limitation of the study was that the author only had access to paper and digital copies of X Academy's eye protection-based training and testing materials.

## Definition of Terms

The follow terms are defined for clarity.

**Disabling work-related injury**. "An injury causing death, permanent disability or any degree of temporary total disability beyond the day of the accident" (Kalman, 1993, p. 31)

**Direct costs**. Workers' compensation and insurance premium increases, emergency calls and medical treatment, equipment repair and legal fees (Honeywell, 2012).

**Eye protection policy**. A policy designed to minimize the potential for eye injury by the provision and use of the correct type of eye protection. (Committee, 2006)

**Indirect costs.** Paid production time lost by non-injured workers (America, The Scope of the Eye Injury Problem, 2010) and damaged company reputation which could hinder hiring and new business efforts (Honeywell, 2012).

**Loco parentis**. The school and its teachers stand in the place of the child's parent by assuming the responsibility for his/her wellbeing (Lathrop & Clark, 1993)

**Safety system**. A system designed to minimize hazards caused by human error. (Geller, 2012)

**Tort law**. Concerns civil wrongs and addresses the duty, breach, and injury sustained to one individual as a result of another's conduct (Drye, 2017)

# Chapter II: Literature Review

This study was focused on analyzing the practices currently being utilized by the X Academy small business "X Woodworkers" in relation to the eye protection and lab safety standard. Laboratory classes may have many goals that include the students' need to learn and understand various concepts to enable the individuals' new-found knowledge to be practiced in a controlled setting, but above all, safety is most important (Dyer & Andreasen, 1999).

One of the main goals in any laboratory class that is usually overlooked by the general public and non-laboratory teachers is that of maintaining a safe environment for the students and the instructor (Polette, 1991), and it is possible that one of the lacking practices relates to eye protection. When reviewing the subject of eye protection in a school lab setting, various topics that should be explored include the costs of eye injuries, statistics of occupational eye injuries, American National Standards Institute (ANSI) eye protection requirements, Occupational Safety and Health Administration (OSHA) personal protective equipment (PPE) standards, and best practices for eye protection in school environments.

## Real Costs of Eye Injuries

It is questionable as to the extent that United States employers actively track the amount of money which is spent treating on-the-job as well as off-the-job injuries that employees experience. However, health care costs are likely to be major concerns for private and government-based companies, and businesses can reduce health insurance and worker compensation costs by initiating an eye safety program that might potentially save workers from devastating eye injuries (Pieper, 2006). The number of disabling work-related injuries was approximately 140,000 in 1995, and the economic costs of those injuries arise from the direct medical expenses and indirect cost, which are caused by lost production time and/worker's

compensation (America, 2010a). The direct financial cost of an eye injury can range from 300 to 3,000 dollars in medical expenses per incident and with indirect costs of 300,000,000 dollars per year due to lost production time and worker's compensation expenses, and it may be surmised that the return on investment for a five to twenty dollar pair of safety glasses and an associated eye safety program is enormous (D'Amato, 2008). While no monetary amount can fully reflect the personal toll that eye injury accidents take on an injured worker or his/her respective family members (OSHA, 2014), it can be surmised that eye injury-related costs are too great to be ignored.

**Tort Law**

While an individual considers the risks that are present within a school lab environment and the potential for direct costs as a result of an eye injury, the presence of legal fees may be a major concern. For teachers who are supervising school shops, Tort Law is relevant. This form of a law involves intentional actions where an individual intends to harm another person (Osborne, 2017) as well as negligence, which is a failure to provide a standard of care that a reasonably prudent person would exercise in a similar situation (Garner, 2009).

One reason why schools are vulnerable to the second negligence aspect of tort law is that the respective employees have a duty to maintain the orderly operation of its school and to promote health, safety, and the welfare of students, or "in loco parentis" (Lathrop & Clark, 1993). Before dealing with inherently dangerous activities, a teacher must warn students of such dangers by means of directions, warnings, and demonstrations. Simply relying on the use of textbooks and handouts without aid of teacher-driven direction could find the teacher over fifty percent negligent for accidents that may occur in a classroom setting (Lathrop & Clark, 1993).

When safety rules are disseminated, such standards must be conveyed verbally in order to avoid liability (Lathrop & Clark, 1993). In the state of Wisconsin, the level of negligence for both the teacher and the student will typically add to a total of one hundred percent. If the teacher is found to be over fifty percent negligent for a student's injures, he/she will incur the cost of the award minus the percent of the student's negligence. If the teacher is found to be less than fifty percent at fault, he/she shall be relieved of all liability (Contributory Negligence, 1998). While the negligence of a teacher may potentially cost a student's normal and productive life, it may also end up costing him/her a large financial sum. That being stated, it would appear intuitive that the proper instruction of safety-related practices must be delivered to the student by his/her applicable teacher.

**Statistics of Occupational Eye Injuries**

While certain eye injury-related statistics can be argued, there should always be the prudent claim that too many individuals are falling victim to eye injuries due to not wearing protective eyewear or not understanding how or what type of PPEs to wear. There are approximately 2,000,000 eye injuries per year in the United State (Brush, 2012) with workplace eye injuries averaging 800,000 per year; however, this number of occupational injuries continues to drop due to the existence of explicit OSHA regulations, improved PPE products, and improved safety practices (Johnson P. , 2012).

The vast majority of occupationally based eye injuries occur from small particles (dust) or larger objects (wood chips, metal slivers, cement chips, nails, staples) which strike the eye. A certain number of the larger objects can result in a permanent loss of vision (NIOSH, 2012). Approximately one-third of occupationally based eye injuries are treated in hospital emergency

rooms and more than one hundred of those cases result in one or more days of lost work (Pieper, 2006).

Just wearing eye protection may not be enough to prevent injury. Studies have shown that approximately forty percent of all eye injuries occurred to workers who were wearing a specific form of eye protection, but in many cases the foreign particles went around the associated protective eyewear being worn due to one or more of numerous factors (improper fit, protection not worn properly, wearing improper protection for the hazards present) (Harris, Whisler, Ammons, Spahr, & Jackson, 2009). Approximately twenty percent of the workers injured while wearing eye protection were only utilizing face shields or welding helmets, while only six percent were wearing goggles (D'Amato, 2008). While analyzing the statistics, one may deduce that simply wearing a form of eye-related PPE is not enough, and that there may be a need to follow the OSHA 1910.132(f) training-related requirements as well as to ensure proper fitting of PPE in order to maximize the effectiveness of such devices.

**American National Standards Institute (ANSI) Z87.1 Eye Protection Design Performance Requirements**

ANSI Z87.1 has been the U.S. standard for eyewear protection for nearly forty years and has experienced numerous updates, (Johnson P. M., 2014) with the most resent occurring in 2015. Within Z87.1-2010 standard, new product requirements have been organized by hazard types in order to address various eye protection characteristics such as impact, coverage and protection from droplets/splashes, dust and fine particles and optical radiation (Sperian, 2010). While all these hazard types have different testing procedures, the protection characteristics of impact and coverage will be overviewed here. The following “high” impact test applies to both the frames and lens:

- High Mass Impact Test
  - A pointed 500 gram projectile is dropped 127 cm on to the protective gear which is fitted on a head form.
  - No part of protective gear can break.
- High Velocity Impact Test
  - A 6.35 mm steel ball is shot at a speed of 45.72 m/s (for spectacles) at six specified impact points of the protective gear fitted on a head form.
  - No part of the protective gear can break.
  - No part of the protective may contact the eye or the head form.

Protectors that pass these tests will be labeled with (Z87+) on lens and frames or housing (ANSI/ISEA, 2010).

The minimum coverage area was new for ANSI Z87.1 in 2010 and this section was not updated in the 2015 version of ANSI Z87.1. This portion of the standard states that the lens must cover no less than 40 mm in width and 33 mm in height as well as be centered on the geometrical center if the lens. For eye protection that is designed for smaller heads, lenses must be no smaller than 34 mm in width and 28 mm in height, as well as be centered on the geometrical center of the lens (ANSI/ISEA, 2010). While ANSI coverage standard may be difficult to understand, 3M has applied this standard to its Eyewear Fit System and uses a coverage and as well as gap gauge to test for coverage. By holding the gauge horizontal, one would place the middle of the gauge "0" approximately in the center of the subject's pupil. If the "H" marks on either side of the "0" lands outside of the lens, the eye protection being tested should not be used by that subject (see Figure 1). By holding the gauge vertical, place the middle of the gauge "0" approximately in the center of the subject's pupil. If the "V" marks on either side of the "0" land

outside of the lens, the eye protection being tested should not be used by that subject (see Figure 2) (3M, 2016).

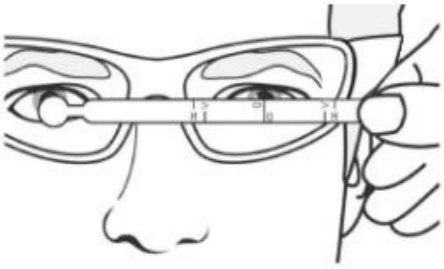

*Figure 1.* Horizontal coverage. (3M, 2016)

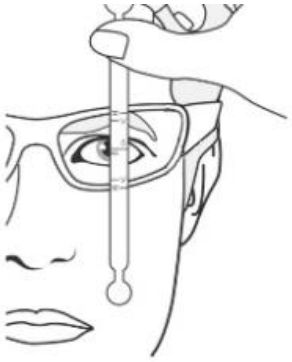

*Figure 2.* Vertical coverage. (3M, 2016)

Understanding the type of hazards that employees/students will encounter in their workplace/classroom is paramount to the correct selection of their eye protection. ANSI has created an eye and face protector selection guide to use once hazard/s have been identified by a safety officer or other knowledgeable, responsible party. Following is a summary of pertinent impact-related criteria that should be used in order to ensure that proper fitting-based considerations are made for an individual who needs to wear protective eyewear:

Table 1

*ANSI/ISEA Z87.1-2010 Eye and Face Protector Selection Guide*

| IMPACT – Chipping, grinding, machining, masonry work, riveting, and sanding | | | |
|---|---|---|---|
| Hazard | Protectors | Limitations | Marking |
| Flying fragments, objects, large chips, particles, sand, dirt, etc. | Spectacles with side protection<br>Goggles with direct or indirect ventilation<br>Faceshield worn over spectacles or goggles<br>Welding helmet | Caution should be exercised in the use of metal frame protective devices in electrical hazard areas. Metal frame protective devices could potentially cause electrical shock and electrical burn through contact with, or thermal burns from exposure to the hazards of electrical energy, which include radiation from accidental arcs.<br><br>Atmospheric conditions and the restricted ventilation of a protector can cause lenses to fog. Frequent cleaning may be required. | Impact rated:<br>+ (spectacle lens)<br>Z87+ (all other lens)<br>Z87+ (plano frames)<br>Z87-2+ (Rx frame) |

(ANSI/ISEA, 2010)

While ANSI standards and selection guide for eye protection makes the task of eye protection selection simpler and more reliable, one must recognize the limitations of each form of protective eyewear that an employee or student may don.

**Occupational Safety and Health Administration (OSHA) Personal Protective Equipment Regulations**

It could be surmised that government-based regulations and standards have made industry safer and more worker friendly by minimizing dangers that exist in the workplace. To reduce the number and severity of eye injuries, people must understand potential eye injury hazards (Matter, Sinclair, & Xiang, 2007). By using the Eye and Face Protection eTool (Appendix A) on OSHA's Web site and by analyzing OSHA regulation 1910.132(d), one can gather that employers as well as teachers must ensure that each affected employee/student uses the appropriate eye and or face protection for the specific hazards that are present and that the respective PPE fits each affected employee/student properly (Pieper, 2006).

The OSHA 1910.133(a)(1) and 1910.132(f)(1) regulations respectively specify an employer's responsibilities that are associated with providing both appropriate equipment and proper training in the use of PPE for employees (Wade, Weimar, & Davis, 2004). While OHSA regulations are reasonably expansive and robust, it should be emphasized that such are meant to be used as a tool to maintain an acceptable level of workplace safety. Portions of the OHSA regulations may not apply to every given situation, and therefore safety officers must know what procedures to follow at a given site in order to ensure that employees are utilizing the correct PPE on a systematic basis (Morgan, 2017).

**Shop Eye Protection Signage**

If one could eliminate safety hazards or place an engineered barrier between workers and a hazardous situation, the need for safety signage would be minimal. However, in the workplace, all hazards cannot be removed or maintained behind a safety wall and thus safety signage must be effectively used to highlight hazards in the workplace (Products, 2009). Employees and students can't be 100% protected from eye related risks and thus safety signage must highlight hazards of the workplace (Vulcan, 2015). ANSI Z535-2011 is a set of standards that relate to safety signage and the respective colors, and is broken down into the following six sub-standards:

- ANSI Z535.1 Safety Colors
- ANSI Z535.2 Environmental and Facility Safety Signs
- ANSI Z535.3 Criteria for Safety Symbols
- ANSI Z535.4 Product Safety Signs and Labels
- ANSI Z535.5 Safety Tags and Barricade Tapes (for Temporary Hazards)
- ANSI Z535.6 Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials (ANSI, 2011b).

While all six standards work together to produce one all-encompassing standard for sign safety, ANSI Z535.4 Product Safety Signs and Labels emphasizes sign word selection which is the most impactful for this study. ANSI Z535 references the following three words in the context of hazard severity:

- Danger; it is almost certain a serious injury or death will occur.
- Warning; it is possible a serious injury or death will occur.
- Caution; serious injury or death is unlikely to occur (ANSI, 2011a)

Although ANSI cites three hazard words, the OSHA standards only cite two; 1910.145(c)(1) Danger signs and 1910.145(c)(2) Caution signs. It should be noted that OSHA does not have a set requirement which indicates that the ANSI standards are to be followed (Products, 2009). Conventional wisdom could lead one to believe that all hazards cannot be removed or maintained behind a safety wall, and for that reason standards for universal safety sign verbiage may reduce the chance of employees or students finding themselves in a harmful situation.

**Implementing an Eye Protection Program**

Implementing a PPE policy can be a difficult process that requires strategies to increase the students' knowledge of equipment and promote favorable attitudes towards its use (Eime, Owen, & Finch, 2004). When employing a PPE policy, the written eye and face protection program should include information regarding when PPE is necessary as well as how to wear, adjust, and care for it and the limitations of the PPE (D'Amato, 2008). Many companies such as Honeywell Safety Products have developed on-line training and resource tools, such as Eye2Eye to increase eye safety awareness and make training available to companies of varying sizes (Rodriguez, 2012). While the OSHA and ANSI standards can direct in the creation of an eye protection program, only a well implemented and firmly enforced organizational-based policy/procedure can produce the correct eye protection behaviors.

**Summary**

While statistics of eye injuries may be questioned, all parties should agree eye and face protection is essential in hazardous environments for both employees and students and that injuries can cost a company capital in both direct and indirect costs. Employers and teachers alike may face legal action by the way of tort law if guidelines are not followed, and thus a successful PPE program will include written eye protection policy that follows both the OSHA and ANSI standards for correct and properly used eye and face protection.

In terms of developing a reliable auditing tool which will assist an individual to evaluate a facility's eye protection program, one should take into account the following standard-related considerations:

- Eye protection signage language is highly standardized through ANSI Z535.4 and by the using uniform verbiage increases the likelihood that employees or students will be aware of hazardous situations.
- The OSHA standard 1910.132(f) lays down a broad frame work for what an instructor needs to cover in order to give employees and/or students the tools needed to work safely in terms of eye protection around hazardous machinery.
- The OSHA standard 1910.132(f) also conveys proper care and maintenance of eye protection that, with the appropriate care and maintenance products, can keep eye protection at a top level of performance, which, in turn, can make a safer shop.

If the above standard-related items are incorporated into a facility auditing tool, then it is likely that an unbiased assessment can be performed of X Academy's shop eye protection practices.

# Chapter III: Methodology

The purpose of this study was to analyze X Academy's lab eye protection training and practices in relation to both various business/industrial standards and government-based regulations. The goals of this study included:

1. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection use in a shop environment.
2. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection care/storage in a shop environment.
3. To identify any gaps in the shop safety signage in X Academy to use eye protection in a shop environment.

## Subject Selection and Description

X Academy's school shop was used as the area for this protective eyewear use safety audit. X Academy's shop is furnished with two computer numerical controlled (CNC) routers, which students use to learn twenty-first century manufacturing skills. Most students at X Academy take one or more computer aided drafting and design (CADD) or computer aided manufacturing (CAM) courses along with at least one woods course where more traditional hand and powered tools are used. The size of X Academy's shop is 50' x 30' with a safety glass storage and disinfected cabinet which is located on the south wall near the main exit door. A 10' x 24' storage room which contains a sink, an eyewash station and air compressor is located at the northeast end of the shop. This audit will be focused on assessing X Academy's eye protection practices in relation to training materials, safety tests, physical shop space, and eye protection cleaning/storage practices.

**Instrumentation**

Information for this safety audit's instrumentation for eye protection training, care, and storage assessment was acquired from OSHA Eye Safety Requirements Overview (Appendix A) and ANSI Z87.1-2010. Material for the safety audit's instrumentation for eye protection signage was attained from OSHA 1910.145 and ANSI Z535-2011. OSHA's and ANSI's eye safety and signage requirements cover numerous items that are not pertinent to eye protection safety of a high school woodshop. As a result of performing the literature review for this study, all standards were pared down to information that addressed the following three sections within the X Academy's classroom and shop settings:

- Eye Protection Signage
    - Warning or Caution signs; Correct use of safety language for safety signage is a must.
    - Safety instruction signs; Although one large sign may convey the message that dangers exist, multiple well placed signs may more effectively alert workers to the potential dangers.
    - Design features; While one may believe the adage "something is better than nothing," that may not be the case if the safety sign itself becomes the hazard.
- Eye Protection Training
    - How to wear, properly care for and maintain eye protection; While donning, caring for and maintaining safety glasses may seem quite ordinary, it could be stated that safety glasses themselves are an integral piece of shop equipment and must be treated as such.

- Shop and tool specific eye protection safety training; One may believe that simply stating that once in a shop setting eye protection must be worn at all time would be an all-encompassing statement that would cover all areas of the shop setting, but seeing different tools may require different eye protection tool specific proper training is necessity.

- Eye Protection Care and Storage; Despite the fact that eye protection is made to pass rigid tests designed by ANSI, the eye protection itself must be treated with as much care as expensive prescription eye wear to keep it in top working condition.

# Eye Protection Safety Audit

| Assessment Conducted By: | | Date of Assessment: | |
|---|---|---|---|

## Eye Protection Policy

| Add written shop eye protection policy (If one exists) | |
|---|---|
| Comments: | |

## Eye Protection Signage (SHOP)

Warning or Caution signs shall be used only to warn against potential hazards or to caution against unsafe practices.
OSHA 1910.145(c)(2)(i)
ANSI Z535.4-2011

Safety instruction signs shall be used where there is a need for general instructions and suggestions relative to safety measures.
OSHA 1910.145(c)(3)
ANSI Z535.4-2011

Design features. All signs shall be furnished with rounded or blunt corners and shall be free from sharp edges, burrs, splinters, or other sharp projections. The ends or heads of bolts or other fastening devices shall be located in such a way that they do not constitute a hazard.
OSHA 1910.145(d)(1)

| Doorways and Tools | Yes | No |
|---|---|---|
| Shop Entrance | ☐ | ☐ |
| Band Saw | ☐ | ☐ |
| Compressed Air Station/s | ☐ | ☐ |
| Disc/Belt Sander | ☐ | ☐ |
| Downdraft Table | ☐ | ☐ |
| Drill Press | ☐ | ☐ |
| Large CNC | ☐ | ☐ |
| Jointer | ☐ | ☐ |
| Tabletop CNC | ☐ | ☐ |
| Radial Arm Saw | ☐ | ☐ |
| Router Table | ☐ | ☐ |
| Miter Saw | ☐ | ☐ |
| Table Saw | ☐ | ☐ |

Comments:

| Eye Protection Training (CLASSROOM) | | | |
|---|---|---|---|
| Each employee shall be trained to know at least the following:<br>When/What eye protection is necessary<br>How to properly don, adjust, and wear eye protection<br>Limitations of the eye protection<br>Proper care, maintenance, useful life, and disposal of the eye protection<br>OSHA 1910.132(f)<br>ANSI Z87.1 10.2, 10.6-2010 | **Safety Training and Tests** | Yes | No |
| | How to Wear Safety Glasses | ☐ | ☐ |
| | Proper Care and Maintenance of Eye Protection | ☐ | ☐ |
| | Shop Eye Protection Safety Training | ☐ | ☐ |
| | Tool Specific Eye Protection Safety Training | ☐ | ☐ |
| Comments: | | | |
| **Eye Protection Care and Storage (SHOP)** | | | |
| Cleaning:<br>Eye protection equipment that has been previously used should be disinfected before being issued to another employee.<br>Storage:<br>Items should be placed in a clean, dust-proof container, to protect them until reissue.<br>OSHA 1910.132(f)(1)(v)<br>ANSI Z87.1 10.4-6-2010 | **Eye Protection Care/Storage** | Yes | No |
| | Eye Protection Cleaning Station | ☐ | ☐ |
| | Eye Protection Storage Cabinet/Case | ☐ | ☐ |
| Comments: | | | |

*Figure 3.* Eye protection safety audit, worksheet.

**Data Collection Procedures**

The assessment-based data was collected from two physical spaces which relate to X Academy's facility classroom and shop. For the classroom setting, the assessor collected applicable training and testing materials and then proceeded to read through all of the assembled resources. While analyzing the materials, anytime that an item fit the criteria for a specific check box on the "Eye Protection Safety Audit" sheet, that box was marked "YES." At the end of the review of the assembled materials, any item that was not marked "YES" was checked as "NO." When a "NO" was marked, the assessor provided comments as needed which clarified what was missing from the materials that caused the unsatisfactory mark.

The eye protection care and storage section was evaluated by a walk-through, which was performed by the assessor of the physical shop space in order to identify particular items on the "Eye Protection Safety Audit" sheet. If items matching the criteria were found, then the "YES" box was marked. If at the end of the walk-through any items were not marked "YES," then such were marked as "NO." When a "NO" was marked, then the assessor provided comments as needed that clarified what was missing from the shop setting that caused the unsatisfactory mark.

The third section, eye protection signage, was evaluated by a walk-through, which was performed by the assessor of the physical shop space to identify particular items on the "Eye Protection Safety Audit" sheet. If items matched the respective criteria, then the "YES" box was marked. If at the end of the walk-through any items were not marked "YES," then such were marked as "NO." When a "NO" was marked, the assessor added in the comment section any clarifying descriptions of what was missing from the shop setting that caused the unsatisfactory mark.

**Data Analysis**

The data analysis of this eye protection assessment process was focused on the occurrence of "YES" and "NO" marks. While the boxes checked as "YES" indicated a that positive steps towards eye protection safety were present, a "NO" mark was viewed as being a less than satisfactory situation where measures needed to be taken to improve shop safety as it relates to eye protection.

**Assumption of the Study**

It is assumed that X Academy is utilizing eye and face-related personal protective equipment (PPE) that is appropriate for the various machine/process hazards that exist within a high school shop environment.

## Limitation of the Study

A limitation of the study was that the assessor only had access to paper and digital copies of eye protection-based training and testing materials.

# Chapter IV: Results

The purpose of this study was to analyze X Academy's lab eye protection training and practices in relation to both various business/industrial standards and regulatory-based standards. The goals of this study included the following:

1. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection use in a shop environment.
2. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection care/storage in a shop environment.
3. To identify any gaps in the shop safety signage in X Academy to use eye protection in a shop environment.

Information for this safety audit's instrumentation was compiled from OSHA and ANSI standards, and the assessment-based data was collected from two physical spaces that relate to X Academy's facility classroom and shop.

## Presentation of Collected Data

As indicated in the completed Eye Protection Safety Audit (see Figure 4), following are the results of X Academy's eye-protection program.

- Eye Protection Policy; No written eye protection policy for X Academy's shop was observed in the review of paper and digital copies of eye protection-based training and testing materials.

- Eye Protection Signage (SHOP)
  - Compressed Air Stations; There are four compressed air stations in X Academy's shop. No eye protection signage was observed at or near any of the compressed air stations.
  - Downdraft Table; X Academy has a shop-made downdraft table that houses four five-inch random orbital sanders. While there are warning labels/sign on each individual sander, there is no warning or caution eye-related signage on or near the downdraft table.
  - Tabletop CNC; No eye protection signage was observed at or near the tabletop CNC in X Academy's shop.
  - Router Table; X Academy has a shop-made router table with a safety guard that has an incorporated viewing and dust collation ports. The router table sits flush with the countertop that is placed on a set of cabinets. While the safety guard itself is robust, the individual who constructed this guard failed to apply eye protection warning or caution signage on or near router table.
- Classroom-Based Eye Protection Training
  - How to Wear Safety Glasses; There was no mention of how to wear safety glasses in the review of paper and digital copies of eye protection-based training and testing materials.
  - Proper Care and Maintenance of Eye Protection; There was no mention of proper care and maintenance of eye protection in the review of paper and digital copies of eye protection-based training and testing materials.

# Eye Protection Safety Audit

| Assessment Conducted By: | K. Stapleton | Date of Assessment: | 5-8-2017 |
|---|---|---|---|

## Eye Protection Policy

| Add written shop eye protection policy (If one exists) | X Academy has no written eye protection policy. |
|---|---|

Comments: See outline

## Eye Protection Signage (SHOP)

Warning or Caution signs shall be used only to warn against potential hazards or to caution against unsafe practices.
OSHA 1910.145(c)(2)(i)
ANSI Z535.4-2011

Safety instruction signs shall be used where there is a need for general instructions and suggestions relative to safety measures.
OSHA 1910.145(c)(3)
ANSI Z535.4-2011

Design features. All signs shall be furnished with rounded or blunt corners and shall be free from sharp edges, burrs, splinters, or other sharp projections. The ends or heads of bolts or other fastening devices shall be located in such a way that they do not constitute a hazard.
OSHA 1910.145(d)(1)

| Doorways and Tools | Yes | No |
|---|---|---|
| Shop Entrance | ☑ | ☐ |
| Band Saw | ☑ | ☐ |
| Compressed Air Station/s | ☐ | ☑ |
| Disc/Belt Sander | ☑ | ☐ |
| Downdraft Table | ☐ | ☑ |
| Drill Press | ☑ | ☐ |
| Large CNC | ☑ | ☐ |
| Jointer | ☑ | ☐ |
| Tabletop CNC | ☐ | ☑ |
| Radial Arm Saw | ☑ | ☐ |
| Router Table | ☐ | ☑ |
| Miter Saw | ☑ | ☐ |
| Table Saw | ☑ | ☐ |

Comments: See outline

## Eye Protection Training (CLASSROOM)

Each employee shall be trained to know at least the following:
When/What eye protection is necessary
How to properly don, adjust, and wear eye protection
Limitations of the eye protection
Proper care, maintenance, useful life, and disposal of the eye protection
OSHA 1910.132(f)
ANSI Z87.1 10.2, 10.6-2010

| Safety Training and Tests | Yes | No |
|---|---|---|
| How to Wear Safety Glasses | ☐ | ☑ |
| Proper Care and Maintenance of Eye Protection | ☐ | ☑ |
| Shop Eye Protection Safety Training | ☑ | ☐ |
| Tool Specific Eye Protection Safety Training | ☑ | ☐ |

Comments: See outline

| Eye Protection Care and Storage (SHOP) | | | |
|---|---|---|---|
| Cleaning:<br>Eye protection equipment that has been previously used should be disinfected before being issued to another employee.<br>Storage:<br>Items should be placed in a clean, dust-proof container, to protect them until reissue.<br>OSHA 1910.132(f)(1)(v)<br>ANSI Z87.1 10.4-6-2010 | **Eye Protection Care/Storage** | Yes | No |
| | Eye Protection Cleaning Station | ☑ | ☐ |
| | Eye Protection Storage Cabinet/Case | ☑ | ☐ |
| Comments: *See outline* | | | |

*Figure 4.* Eye protection safety audit, finished worksheet.

**Discussion**

X Academy's lack of a written eye protection policy could leave students confused about when eye protection is needed. In addition, students may be uncertain of the type of eye protection that should be worn during the use of a specific tool or operation in the shop setting. This type of disorganization may make it difficult to firmly enforce eye protection rules that were reviewed during applicable safety training. Lastly, the students' inability to view an eye protection policy could minimize their ability to fully grasp why the teacher is instructing them in the shop, and thus lead to less than favorable attitudes towards eye protection.

While the eye protection signage in X Academy's shop shows a need for improvement, the author did notice that all professionally manufactured tools, with exception of the tabletop CNC, were equipped with necessary safety signage. Where X Academy's signage was lacking was in respect to shop-made tools or workstations and in failing to apply proper signage. Lack of signage on shop-made tools leaves the end-user at a greater risk than when he/she is using a professional manufacture tool. Professionally manufactured tools typically adhere to the ANSI Z535 standards with regard to constructing or choosing signage that clearly conveys critical hazard-related information to the user in compliance with the OSHA 1910.145(c) and 1910.145(d)(1) regulations.

Based on the results of the assessment process, eye protection training in regard to how an individual should don safety glasses and the proper care and maintenance of eye protection was found to be lacking at X Academy. None of the assembled paper or digital copies of eye protection-based training and testing materials referenced the OSHA 1910.154(c) and 145(d)(1) standards that would fulfill the PPE training-based requirement as set forth by the OSHA 1910.132(f) regulations. Students who are not properly trained according to OSHA 1910.132(f) could have uncomfortable and/or improperly adjusted eye protection. In addition, without proper training, students may not know how to correctly care for and maintain their eye protection. Individuals are less likely to wear eye protection if it fits improperly, is uncomfortable, or causes minor vision distortion that may be caused by poor care of the associated PPE (Johnson P. , 2012).

# Chapter V: Conclusions and Recommendations

The purpose of this study was to analyze X Academy's lab eye protection training and practices in relation to both various business/industrial standards and regulatory-based standards. The goals of this study included the following:

1. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection use in a shop environment.
2. To identify any gaps in the training process that the X Academy utilizes to prepare students regarding eye protection care/storage in a shop environment.
3. To identify any gaps in the shop safety signage in X Academy to use eye protection in a shop environment.

Information for the development of s this safety audit's instrumentation was compiled from OSHA and ANSI standards, and the assessment-based data was collected from two physical spaces that relate to X Academy's facility classroom and shop.

## Conclusions

Following are logical conclusions that may be drawn from the data that was collected as part of this study:

- X Academy has no written eye protection policy and, without written policy training lessons and a corresponding test, appear to have no focal point or end goal in mind with regard to directing students on safety. Teaching without an end point in mind can leave students confused and frustrated, which ultimately may lead to such individuals not adhering to various aspects of the organization's safety program.
- Eye safety signage in X Academy's shop as it relates to professionally manufactured tools receives very high marks in relation to OSHA and ANSI standards for safety

signage. On the other hand, shop-made tools and fixtures fail to indicate any thought of required OSHA and/or ANSI standards of eye protection or general safety signage, which in turn may place students who are working on these tools at greater risk for a serious injury.

- Eye protection training in regard to shop activities as well as instruction given for specific tool use seems to be covered adequately in regards to the OSHA 1910.132(f) standard. However, minimal evidence was found in the paper and digital copies of eye protection-based training/testing materials with regard to properly donning as well as the care and maintenance of eye protection. This issue leads the author of this study to believe that the training of these two crucial points within eye protection safety needs to be improved.

**Recommendations**

The profession of a high school technology teacher may find such an individual wearing many different hats. Expecting a teacher to be an expert in OSHA and ANSI standards as well as having the knowledge on how to properly apply such could asking a tremendous amount from an individual who may not have been professionally trained in the areas of safety or risk management. With careful consideration, the author offers these recommendations;

- Have shop supervisor and students take part in a professionally developed safety program such as Eye2Eye by Preventblindness.org in order to improve student training-based materials.
- Have instructor take part in OSHA 10-Hour Training course in order to better understand the OSHA regulations and how such can be applied in a shop setting.

- Schedule a shop walk-through and meeting with the school district's Safety Officer or an outside safety consultant in order to learn about risks in the shop setting and develop plans to:
    - Improve eye protection-based training materials.
    - Develop a written eye protection policy.
    - Develop signage in regards to shop-made tools/equipment.

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# Appendix: "OHSA Eye Safety Requirements Overview" Adapted from OSHA's eTools

(Pieper, 2006)

OSHA requires employers to ensure the safety of all employees in the work environment. Eye and face protection must be provided whenever necessary to protect against chemical, environmental, and radiologic hazards or mechanical irritants. Ensuring worker safety includes conducting a workplace hazard assessment and providing adequate training for all workers who require eye and face protection. When employees are trained to work safely, through the following requirements, they should be able to anticipate and avoid injury from job-related hazards.

**OSHA standards**

The following OSHA standards provide mandatory requirements and compliance assistance for employers when selecting proper eye and face protection:

- 1910.132 -General requirements
- 1910.133 -General Industry
- 1915.153 -Maritime
- 1926.102 –Construction

The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. To select personal protective equipment (PPE) for the workplace, see the Hazard Assessment module accompanying the OSHA Eye and Face Protection eTool (*www.osha.gov/SLTC/etools/eyeandface*).

**Training and qualification of employees**

Employers must provide training for each employee who is required to use PPE in the workplace. [1910.132(f)]

- Each employee shall be trained to know at least the following:
    - When PPE is necessary
    - What PPE is necessary
    - How to properly don, doff, adjust, and wear PPE
    - Limitations of the PPE
    - Proper care, maintenance, useful life, and disposal of the PPE
- All training should be conducted by a knowledgeable designated person.
- All required training should be presented in a manner that the employee can understand.
- Each affected employee shall demonstrate an understanding of the training specified and the ability to use PPE properly before being allowed to perform work requiring the use of PPE.
- Employers who allow their employees to wear eye and face protection on a voluntary basis, when not required by OSHA or the employer, must implement limited provisions of a PPE program. For all other voluntary users, an additional written eye and face protection program that covers proper maintenance procedures must be implemented.

**Retraining**

- When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required, the employer shall retrain that employee. Circumstances under which retraining is required include, but are not limited to:
    - Changes in the workplace render previous training obsolete

  - Changes in the types of PPE to be used render previous training obsolete
  - Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill

**Written certification**

- The employer shall verify that each affected employee has received and understands the required training through a written certification that contains the name of each employee trained, the date(s) of training, and the subject of the certification.

**Handling emergencies**

- If an eye injury occurs, quick action can prevent a permanent disability. For this reason:
  - Emergency eyewashes should be placed in all hazardous areas.
  - First-aid instructions should be posted close to potential danger spots.
  - Employees must know where the closest eyewash station is and how to get there with restricted vision

**Criteria for personal protective eyewear**

Eye and face protection must comply with the American National Standards Institute, ANSI Z87.1-1989 standard if purchased after July 5, 1994, or ANSI Z87.1-1968 if purchased before July 5, 1994 [1910.133(b)(1), 1915.153(b), 1926.102(a)(2)].

- Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer [1910.133(a)(4)].
- The following minimum requirements must be met by all protective devices:
  - Provide adequate protection against the particular hazards for which they are designed
  - Be of safe design and construction for the work to be performed
  - Be reasonably comfortable when worn under the designated conditions
  - Fit snugly and not unduly interfere with the movements of the wearer
  - Be durable
  - Be capable of being disinfected
  - Be easily cleanable
  - Be distinctly marked to facilitate identification only of the manufacturer

**Fitting personal protective eyewear**

Consideration should be given to comfort and fit. Poorly fitting eye and face protection will not offer the necessary protection [1926.102(a)(6)(iii)].

- Fitting of goggles and safety spectacles should be done by someone skilled in the procedure.
  - Prescription safety spectacles should be fitted only by qualified optical personnel.
- Devices with adjustable features should be fitted on an individual basis to provide a comfortable fit that maintains the device in the proper position.
- Eye protection from dust and chemical splash should form a protective seal when fitted properly.
- Welding helmets and face shields must be fitted properly to ensure that they will not fall off during work operations.

**Maintenance and care of personal protective eyewear**

Employees must be trained in the proper care, maintenance, useful life, and disposal of PPE [1910.132(f)(1)(v)].

**Maintenance**

- PPE must be used and maintained in a sanitary and reliable condition.
- The use of equipment with structural or optical defects is prohibited [1926.102(a)(4)].
- Pitted lenses, like dirty lenses, can be a source of reduced vision. They should be replaced. Deeply scratched or excessively potted lenses are apt to break.
- Slack, worn-out, sweat-soaked, or twisted headbands do not hold the eye protector in proper position. Visual inspection can determine when the headband elasticity is reduced to a point below proper function.

**Cleaning**

- Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
- Eye and face protection equipment that has been previously used should be disinfected before being issued to another employee.
- When employees are assigned protective equipment for extended periods, the equipment should be cleaned and disinfected regularly.
- Several methods for disinfecting eye-protective equipment are acceptable. The most effective method is to disassemble the goggles or spectacles and thoroughly clean all parts with soap and warm water.
    - Carefully rinse all traces of soap and replace defective parts with new ones.
    - Swab thoroughly and immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide.
    - Remove parts from solution and suspend in a clean place for air drying at room temperature or with heated air.
    - Do not rinse after removing parts from the solution because this will remove the germicidal residue that retains its effectiveness after drying.

**Storage**

- Goggles should be kept in a case when not in use. Spectacles, in particular, should be given the same care as one own glasses, as the frame, nose pads, and temples can be damaged by rough usage.
- Items should be placed in a clean, dust-proof container, such as a box, bag, or plastic envelope, to protect them until reissue.

**Contact lenses and prescription lenses in the workplace**

Employers must ensure that employees who wear prescription (Rx) lenses or contacts use PPE that incorporates the prescription, or use eye protection that can be worn over prescription lenses [1910.133(a)(3), 1915.153(a)(3), 1926.102(a)(3)].

- Workers who wear prescription glasses must also wear required eye protection.
    - Eye and face protection that fits comfortably over glasses is available.
    - Safety goggles and spectacles may incorporate prescription lenses.

- Dust and chemicals present additional hazards to contact lens wearers. OSHA recommends that workers have an extra pair of contacts or eyeglasses in case of contact failure or loss.

The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. A summary of the basic types of workplace eye hazards, to be considered when selecting safety eyewear, is provided in the Hazard Assessment module below.

| Hazard type | Examples of hazard | Common related tasks |
|---|---|---|
| Impact | Flying objects such as large chips, fragments, particles, sand, and dirt | Chipping, grinding, machining, masonry work, wood working, sawing, drilling, chiseling, powered fastening, riveting, and sanding |
| Heat | Anything emitting extreme heat | Furnace operations, pouring, casting, hot dipping, and welding |
| Chemicals | Splash, fumes, vapors, and irritating mists | Acid and chemical handling, degreasing, plating, and working with blood |
| Dust | Harmful dust | Woodworking, buffing, and general dusty conditions |
| Optical Radiation | Radiant energy, glare, and intense light | Welding, torch-cutting, brazing, soldering, and laser work |