An occupational vision survey of BIAMP

Courtney Goetsch
Pacific University

Stephanie Parrish
Pacific University

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An occupational vision survey of BIAMP

Abstract
In the industry at BIAMP there is an unmet need of vision care amongst the variety of employees that work at BIAMP. BIAMP includes many employees who spend hours working on very small pieces of equipment with intricate detail and fine movements. There were previously no visual requirements or screenings available for employees. We went into StAMP’s production and office areas and evaluated the working conditions. After talking with management we discovered the needs and expectations of each work area. We were led on a tour of the facility and provided with information regarding the activities that occurred there. The lighting and safety conditions in each area of the factory were observed. Based on our information attained, the facility was subdivided into nine categories. A detailed screening was designed and performed to incorporate the specific demands of each category. Minimum visual requirements were established and those who did not meet these requirements were referred for additional testing and possible visual aids. Upon completion an analysis of the screenings was compiled, including our recommendations for improvement in safety and lighting as well as treatment for their employees.

Degree Type
Thesis

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AN OCCUPATIONAL VISION SURVEY OF BIAMP

BY
COURTNEY GOETSCH
STEPHANIE PARRISH

Design and implement a vision screening program to improve the safety and efficiency of the employees at BIAMP.

16-July, 2004

A thesis submitted to the faculty of the College of Optometry Pacific University Forest Grove, Oregon for the degree of Doctor of Optometry May 2006

Advisor:
Kenneth Eakland O.D.  Associate Dean for Clinical Programs at Pacific University
Courtney Goetsch
I attended undergraduate school at Northeast Community College from August 1995 to May 1997 pursuing a degree in Criminal Psychology. I changed my major to Pre-Optometry and attended Wayne State College from August 1997 to December 2001 receiving a B.S. in Life Sciences and Biology. In August 2002 I became enrolled at Pacific University College of Optometry. As a student at Pacific College of Optometry I have had the honor of representing the students of Pacific University College of Optometry as the American Optometric Student Association's Trustee. Not only did I serve as the AOSA Trustee at Pacific University, but I also served as the student representative for Pacific's Academic and Professional Standards Committee, I served as the National Liaison for the Infants and Children's Vision Coalition, and I served as the Local Liaison for both NBEO and ASCO. I am a student member of the COVD, the AOA-PAC, AMIGOS, and Beta Sigma Kappa. I am also currently serving as the secretary on the executive council of the National AOSA. Throughout undergraduate and optometry school I have been involved in several extracurricular activities and volunteer work. I received the AcuVue Eye Health Advisor Student Citizenship Scholarship in 2004 and the student grant from the Heart Land of America Contact Lens Section in 2005.

I plan to continue being involved in organized optometry and to join a group practice in Nebraska. I hope to work mostly in pediatric optometry.

Stephanie Parrish
I attended undergraduate from 1998-2002 at the University of North Dakota where I received a Bachelor of Science in Biology and a minor in Chemistry. At UND I participated in many activities including the honor society. I then attended Pacific University College of Optometry from 2002-2006. My future plans are to find a job working with the geriatric population in co-management with ophthalmology.
Abstract

In the industry at BIAMP there is an unmet need of vision care amongst the variety of employees that work at BIAMP. BIAMP includes many employees who spend hours working on very small pieces of equipment with intricate detail and fine movements. There were previously no visual requirements or screenings available for employees.

We went into BIAMP's production and office areas and evaluated the working conditions. After talking with management we discovered the needs and expectations of each work area. We were led on a tour of the facility and provided with information regarding the activities that occurred there. The lighting and safety conditions in each area of the factory were observed. Based on our information attained, the facility was subdivided into nine categories. A detailed screening was designed and performed to incorporate the specific demands of each category. Minimum visual requirements were established and those who did not meet these requirements were referred for additional testing and possible visual aids. Upon completion an analysis of the screenings was compiled, including our recommendations for improvement in safety and lighting as well as treatment for their employees.
Acknowledgements

A special thank you to BIAMP for their willingness to participate in the visual screening and provide information and resources for the survey. Also, thank you to Dr. Ken Eakland for providing his expertise in the area of Occupational Optometry. Thank you to Dr. Ken Eakland, Jamie Anderson, Angie Smith, and Neil Vanderhorst for helping in the screening process.
An Occupational Vision Survey of BIAMP

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Benefits of Providing Vision Care to Employees at BIAMP

Vision is a very important and often essential part of performing tasks on the job. As employees in a company such as BIAMP, where almost every task requires the use of their eyes, it is very necessary to protect them. In today's world of lawsuits and litigations it is essential to be thorough and exact in providing eye safety. BIAMP has recognized the importance of implementing vision care safety systems within their working environment.

Consulting an Optometrist for the prevention of occupational eye injuries is essential. The negative effects of such injuries to both the employee and employer are immense. According to the National Institute for Occupational Safety and Health (NIOSH)\(^6\), each day over 2000 U.S. workers have job related eye injuries that require medical treatment. This equates to approximately one million eye injuries per year. Of these over 100,000 will miss work and over 300,000 will result in disabling injuries. These injuries total a financial loss totaling over $15,000 dollars per person injured, including both indirect and direct costs. These include emergency room costs, training a replacement employee, insurance and disability coverage. Beyond the dollar sign there are emotional and physical costs that cannot have monetary estimates attached.

According to NIOSH\(^6\), "The majority of these injuries result from small particles or objects striking or abrading the eye. Examples include metal slivers, wood chips, dust, and cement chips that are ejected by tools, wind blown, or fall from above a worker. Some of these objects, such as nails, staples, or slivers of wood or metal penetrate the eyeball and result in a permanent loss of vision. Large objects may also strike the eye/face, or a worker may run into an object causing blunt force trauma to the eyeball or eye socket. Chemical burns to one or both eyes from splashes of industrial chemicals or cleaning products are common. Thermal burns to the eye occur as well. Among welders, their assistants, and nearby workers, UV radiation burns (welder's flash) routinely damage workers' eyes and surrounding tissue."
The Bureau of Labor Statistics conducted a study in 1980 determining the cause of eye injuries that occur in the workplace. They showed that 60% of injuries occurred because no eye protection was worn. The remaining eye injuries (40%) occurred because incorrect eye protection was being worn for the specific task. As a result of this study new ANSI standards were put into place in 1989. It is essential for employers to consult eye care professionals to insure proper safety eyewear and working conditions.

The value of companies consulting eye care practitioners is not limited to providing safety consultations, but also includes evaluating the visual functions and abilities of their employees.

Production is a factor that all companies are eager to improve. There are many ways to improve productivity from improved training, to streamlining processing, to making sure that the employees have the ability to perform their assigned tasks to their utmost potential. It is our job to educate companies in the role that vision plays in increasing the productivity and accuracy of their employees. Vision is necessary for the intricate demands of placing small parts on the boards, working on the computer, managing accounts, and testing the final product of the boards.

Another constraint on productivity is eyestrain. Eyestrain is the primary cause of many headaches and fatigue at the end of the workday, which has been shown to decrease production numbers and increase production errors according to the National Institute of Occupational Safety and Health (NIOSH). Proper visual intervention has the potential to greatly decrease the level of visual strain, leading to fatigue at the end of a long workday. This will benefit the company by improving the performance and attitude of the employee. It can be logically deduced that the less fatigue an employee feels at the end of the workday, the more motivated they will be to get up the next day and go to work, and the more enjoying their work will be.
It is reasonable that when employees feel supported by the company they work for, they will perform at higher levels and often times an increase in production has been reported. According to the American Optometric Association\(^2\), there are three "golden rules" for industry:

**"The Golden Rules"**

1. What is good for the employee is good for the company.
2. Protect your employees as you would your own family.
3. Industrial ethics includes putting the interest of protecting your employee foremost.

Keeping the "golden rules" for industry in mind, we can conclude that employees have the desire to work for a company that they feel is taking care of them and their families.

When companies provide visual screenings for their employees it relays not only their concerns of preventing injuries at the work place, but also their concerns about their employees' general health\(^{11}\). In performing the occupational vision screenings the eye care practitioner is able to screen for both ocular and systemic diseases, along with visual functioning. It is the optometrist's primary goal to attempt to meet the needs of patients by preventing and treating disease, as well as providing correction for any refractive errors and inadequate visual functioning. By performing yearly screenings it greatly increases the chance of catching a vision-threatening or even life-threatening condition early. Many diseases that occur in people often have symptoms that present in the eye. By catching these things early there is a much greater chance of prevention of damage and the possibility of saving eyesight and lives. This is obviously beneficial for the employees but will also benefit BIAMP both financially and in building personnel relations.
Analysis of Working Areas

In developing a visual screening program for a company, such as BIAMP, it is very important to first do an analysis of the working areas\(^1\). It is obvious in companies of this size that there are many different visual requirements in each unique job. In each area of work the following should be considered: Visual needs such as auxiliary lenses; activities and visual requirements such as seeing fine detail or color discrimination; available lighting; and safety needs. The analysis of the working areas will help to develop a specific visual screening with specific pass/fail requirements customized to each work area. It will also aid in developing a plan to improve visual working conditions for each employee and help the optometrist gain a better understanding of any visual concerns an employee may present with during the screening.

The working areas at BIAMP, were divided into four general areas of activities as a result of an on-site walk through evaluation\(^3\). An official safety/occupational evaluation was not conducted at the time of the walk through. It would be our recommendation as well as in the best interest of BIAMP to have an official survey conducted by eye care professionals.

For our screening purposes we have divided the employees into the following categories:

<table>
<thead>
<tr>
<th>Employee Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General Office Area</td>
</tr>
<tr>
<td>2. Manufacturing and Testing</td>
</tr>
<tr>
<td>3. Engineering</td>
</tr>
<tr>
<td>4. Shipping and Receiving</td>
</tr>
</tbody>
</table>
### 1. General Office Area

<table>
<thead>
<tr>
<th>Specific Area</th>
<th>Activity</th>
<th>Visual Demands</th>
<th>Current Visual Compensation</th>
<th>Potential Safety Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office and Administrative Areas</td>
<td>- Standard office activities.</td>
<td>- Computer usage at standard distances.</td>
<td>- Lighting adequate</td>
<td>- Limited exposure to chemicals, flying objects, falling objects, dust particles etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Paper work at standard distances.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2. Manufacturing and Testing

<table>
<thead>
<tr>
<th>Specific Area</th>
<th>Activity</th>
<th>Visual Demands</th>
<th>Current Visual Compensation</th>
<th>Potential Safety Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Shop</td>
<td>- Metal Fabrication&lt;br&gt;Computer use&lt;br&gt;Layout and measurements&lt;br&gt;Operation of metal former and cutoff tools</td>
<td>- General reading level&lt;br&gt;Large scale intermediate distance tasks&lt;br&gt;Limited high detail near activities</td>
<td>- Lighting Adequate&lt;br&gt;Adequate eye protection for metal fabrication</td>
<td>- Extensive exposure to chemicals, flying particles, falling objects and dust particles.</td>
</tr>
<tr>
<td>Paint Area</td>
<td>- Applies paint labels and details to completed metal housing</td>
<td>- High level of intermediate visual demands&lt;br&gt;High level near vision accuracy for alignment and quality assurance&lt;br&gt;High level of contrast and color sensitivity required</td>
<td>- Adequate eye protection for utilizing chemicals and paints&lt;br&gt;Screened masks</td>
<td>- Extensive exposure to chemicals and moderate exposure to flying objects and dust particles.</td>
</tr>
<tr>
<td>Circuit Board Manufacturing</td>
<td>- Employees required to load the equipment and track progress via computer screens located at standing eye level&lt;br&gt;Employees perform quality inspections after first stage manufacturing</td>
<td>- Minimal Computer work&lt;br&gt;Computers placed high in visual space&lt;br&gt;Inspection detail is at very high visual demand&lt;br&gt;Visual spatial accuracy is critical</td>
<td>- Lighting is low on the inspection table but improved under the stand magnifiers&lt;br&gt;Employees are provided a high-powered projection magnifier&lt;br&gt;Adequate eye protection for line manufacturing</td>
<td>- Limited exposure to chemicals, flying objects and dust particles.</td>
</tr>
<tr>
<td>Manual Component Assembly</td>
<td>- Re-inspect automated manufacturing&lt;br&gt;Hand placement of large and small components</td>
<td>- Accurate visual spatial localization required</td>
<td>- Magnifiers are present for use and seem to be adequate&lt;br&gt;Illumination is adequate with each station individually illuminated with indirect fluorescents&lt;br&gt;Adequate eye protection for part assembly</td>
<td>- Limited exposure to chemicals, flying objects, and dust particles.</td>
</tr>
<tr>
<td>Solder Unit</td>
<td>Un • Assembled circuit boards are located onto an automated solder unit for completion</td>
<td>• Inspection of boards; Visual Accuracy at near is critical</td>
<td>• Unable to evaluate</td>
<td>• Unable to thoroughly evaluate ocular exposure to solder burn, chemicals, flying objects and dust particles at time of walk through.</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-----------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Final Assembly</td>
<td>• Overall inspection of boards • Assemble a variety of components to the main circuit board</td>
<td>• Visual tasks require high spatial accuracy • Visual demands are high regarding small detail analysis</td>
<td>• All work is performed at a work station under both direct and indirect fluorescent lighting • Magnifiers are available for use</td>
<td>• Limited exposure to chemicals, flying objects, and dust particles. Standard for assembly</td>
</tr>
<tr>
<td>Electrical Testing</td>
<td>• Employees utilize a variety of computer readouts, recording devices and measuring devices to evaluate system performance</td>
<td>• Computer screens at standard viewing levels • Visual requirements range from slightly above eye level to standard reading plane • Distances are at standard near and intermediate</td>
<td>• Adequate eye protection for electrical assembly and testing</td>
<td>• Limited exposure to chemicals, flying objects, and dust particles. Standard for testing and assembly</td>
</tr>
<tr>
<td>Assembly of Final Product</td>
<td>• Employees assemble the completed circuit boards</td>
<td>• Assembly work utilizes small finishing screws • Requires strong visual spatial localization • Requires strong eye-hand coordination</td>
<td>• Adequate eye protection for assembly</td>
<td>• Limited exposure to chemicals, flying objects, and dust particles. Standard for testing and assembly</td>
</tr>
<tr>
<td>Final Electric Product Testing</td>
<td>• Testing for electrical output and accuracy</td>
<td>• Computer screens at standard viewing levels • Visual requirements range from slightly above eye level to standard reading plane • Distances are at standard near and intermediate</td>
<td>• Adequate eye protection for electrical testing and assembly</td>
<td>• Limited exposure to chemicals, flying objects, and dust particles. Standard for electrical testing and assembly</td>
</tr>
</tbody>
</table>
### 3. Engineering

<table>
<thead>
<tr>
<th>Specific Area</th>
<th>Activity</th>
<th>Visual Demands</th>
<th>Current Visual Compensation</th>
<th>Potential Safety Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>• Software and hardware development and testing</td>
<td>• Computer viewing at standard distances</td>
<td>• None</td>
<td>• Limited exposure to chemicals, flying objects, falling objects, dust particles etc. Standard for general shipping/receiving</td>
</tr>
</tbody>
</table>

### 4. Shipping and Receiving

<table>
<thead>
<tr>
<th>Specific Area</th>
<th>Activity</th>
<th>Visual Demands</th>
<th>Current Visual Compensation</th>
<th>Potential Safety Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging/Shipping and Receiving</td>
<td>• Preparing final product for shipping</td>
<td>• General distance, intermediate and near activities</td>
<td>• None</td>
<td>• Limited exposure to chemicals, flying objects, falling objects, dust particles etc. Standard for general shipping/receiving</td>
</tr>
</tbody>
</table>
Review of Tests Conducted and BIAMP Data Collected

Each employee was provided with an intake form (Appendix A) to fill out prior to the screening held at BIAMP. On this intake form information such as age, date of last eye exam, last medical exam, and correction worn were provided.

Age of employees at BIAMP was of importance as it determines screening protocols, expectancies and recommendations. The majority of BIAMP employees were between the ages of 40 and 50 years.

Age

![Age Distribution Pie Chart]

- 4% of employees are in the 20-30 age group.
- 10% are in the 30-40 age group.
- 21% are in the 40-50 age group.
- 24% are in the 50-60 age group.
- 41% are in the 60-70 age group.
The recommendation by the American Optometric Association for frequency of eye exams is every other year unless recommended more frequently by an individual's eye care professional. The majority of BIAMP's employees had an eye exam within the last year, however six percent had not had an eye exam within the last 4-5 years.

Last Eye Exam

When evaluating an individual's general ocular health it is also important to inquire about their last medical examination. Many times bodily diseases and ailments can affect the eyes. At BIAMP, most employees reported having their last medical exam within the last year.

Last Medical Exam
While evaluating a patient’s vision it is essential to know the current type of correction worn. Employees at BIAMP, reported on their intake forms which type of correction they wear. Approximately one third of the employees reported wearing no correction, and a small percentage reported wearing contact lenses for correction. According to Jobson Publishing LLC. 61% of Americans wore some kind of vision correction in the year 2001 and is estimated to climb by the year 2005.

People Wearing Vision Correction

![Pie Chart]

- **Glasses**: 67%
- **No Correction**: 30%
- **Contact Lenses**: 3%
During the screening there were many tests conducted and each of them were conducted for a specific purpose. We would like to provide you with those tests, the reasons for conducting them, and the data collected from employees at BIAMP.

1. Habitual Visual Acuities (Distance & Near) – Provides us with information as to how well the employee is able to see a standard chart with their current lens prescription.

**Distance Visual Acuities**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>8%</td>
<td>Worse than 20/30</td>
</tr>
<tr>
<td>92%</td>
<td>Passed</td>
</tr>
</tbody>
</table>

**Near Visual Acuities**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>7%</td>
<td>Worse than 20/30</td>
</tr>
<tr>
<td>93%</td>
<td>Passed</td>
</tr>
</tbody>
</table>

Eight percent of the employees at BIAMP did not pass the distance visual acuities test. Seven percent of the employees at BIAMP did not pass the near visual acuities test. Anyone experiencing 20/30 or worse vision is potentially at risk of low performance and safety issues on the job. Decreased vision also is an indicator of possible ocular complications that should be referred for a comprehensive vision exam.
2. **Cover Tests (Distance & Near)** – This test allows us to evaluate the alignment of the eyes and to assess if any eye turns are present. This is important to evaluate the ability of the employee to use both of their eyes together and their potential to perceive depth. If an employee suffers from poor depth perception it is likely that they may have difficulty placing small parts and recognizing fine detail.

### Near Cover Test

- **Passed**: 69%
- **No Pass**: 31%

### Distance Cover Test

- **Passed**: 93%
- **No Pass**: 7%

Thirty-one percent of the employees at BIAMP did not pass the near cover test.
Seven percent of the employees at BIAMP did not pass the distance cover test.
3. **Pupils** – Aids in determining the presence of abnormal neurological issues affecting the eyes. If we pick up an abnormal pupil function the employee can be referred for a further neurological workup or brain imaging.

### Pupils

- **Defects - No Pass**
- **No defects - Passed**

Three percent of the employees at BIAMP exhibited Pupil defects, equally 2 employees.
4. **Intraocular pressure** – Screening test for Glaucoma, a disease that will cause loss of vision in patients who are diagnosed with it. According to the Glaucoma Research Foundation\(^4\), 2% of people in the U.S. between the ages of 40-50 and 8% over the age of 70 have intraocular pressures that put them at risk for developing glaucoma.

### Intraocular Pressure

![Pie Chart]

Twenty Five percent of the employees at BIAMP had Intraocular pressures greater than 20mmHg.
5. **Ophthalmoscopy** – Permits us to view the back of the eye and assess the health of ocular tissues. There are many ocular and systemic diseases that can be picked up by observing any changes in the back of the eye.

There were only 4 employees of BIAMP that exhibited clinical concern with ophthalmoscopy findings. These employees were referred for further examination.

6. **Near Point Convergence** – Tests the ability of the patient to focus their eyes on near objects. This is important for patients who perform a lot of near tasks, as it can be an indicator for possible eyestrain and headaches.

***Near Point of Convergence***

Forty-four percent of the employees at BIAMP did not show efficient near point convergence amplitude. According to Optometrist network, 3-8% of Americans have a reduced NPC. An Optometrist can recommend appropriate vision therapy and/or glasses.
7. **Accommodative Facility** – Enables us to test the employees' ability to change their focus from near to distance activities. This gives us an idea as to the possible amount of work their eyes have to do just to maintain clear images. If an employee has difficulty in this area they are likely to experience tired eyes and possibly headaches at the end of the day. In statistical analysis Presbyopes were not considered No Pass because they naturally will have a low accommodative facility that is corrected with bifocals.

**Accommodative Facility**

![Accommodative Facility Chart]

Ten percent of the employees at BIAMP have shown inadequate accommodative facility. The prevalence in the U.S. is 1.5-6% according to Dr. Dennis Smith O.D.\(^{11}\)

8. **Vergence Facility** – This helps us determine the ability of the employee to converge and diverge their eyes with different near and distance tasks. This is essential for many of the tasks performed at BIAMP as near work is a primary part of many of their jobs. If converging their eyes together is difficult this places unneeded strain on their eyes and may slow down productivity.

**Vergence Facility**

![Vergence Facility Chart]

Twenty eight percent of the employees at BIAMP demonstrated insufficient Vergence facility. According to Dr. Dennis Smith O.D.\(^{11}\), vergence infacility is present in approximately 16% of the population.
9. **Stereoscopy** – Evaluates the employees' ability to fuse objects together and to integrate their visual information into depth perception on a neural level. This is very important to assess their speed and efficiency of their brain eye coordination.

![Stereoscopy Pie Chart](image)

Six percent of the employees at BIAMP did not pass this portion of the screening. Low stereo vision can be an indicator decreased binocular function, amblyopia, and/or uncorrected refractive error.
10. **Color Vision (D15)** – Allows us to evaluate the employees’ ability to perceive differences in color and to quantify those missing areas. This is essential for many of the tasks that employees at BIAMP are expected to perform on a daily basis such as painting or assembling boards, etc.

**Color Vision**

Eighteen percent of the employees at BIAMP demonstrated color defects. According to Dr. Jeff Rabin O.D. hereditary color deficiencies present in 4.5% of the population (8-10% males; 0.5% females). There are also pathological causes of color vision loss that cause color vision to change from normal to abnormal. These patients need to be seen for a comprehensive vision exam.
11. **Visual Field Assessment** – Determines if the employees' peripheral and central vision is present and where they might have missing areas. This is important to possibly catch early disease processes.

**Visual Field Defects**

Twenty eight percent of the employees at BIAMP had visual field defects. Whenever a visual field defect presents it is imperative that the patient seek further testing to determine the cause of the visual field loss. Some of the more common causes include neurological problems, glaucoma, and trauma.

12. **Contrast Sensitivity** – Evaluates the ability to distinguish between fine detail and light intensities. This is important for looking at different shades of color while working with small parts.

**Contrast Sensitivity**

One hundred percent of the employees at BIAMP passed contrast sensitivity.
13. **Auto refractor** – This is an objective way to measure the refractive error of the eye. It gives us an estimate of the possible lens prescription that might be necessary for the employee.

### Refractive Error

![Pie chart showing refractive error distribution]

- 52% Myopia
- 44% Hyperopia
- 4% Emmetropia

Fifty-two percent of BIAMP's employees are myopes, forty-four percent are hyperopes and four percent are emmetropes. The U.S. national average is about 30% Myopic, 23% Hyperopic and 47% Emmetropic. Refractive error is unique to each individual and is correctable with spectacle or contact lenses.

### Presbyopia

![Pie chart showing presbyopia distribution]

- 25% Presbyopic
- 75% Non-presbyopic

Anyone over the age of 40 is generally loosing the ability to focus at near and is classified as a presbyope. Treatment for presbyopia is extra plus lenses for near vision, which can be prescribed in a bifocal, trifocal or reading glasses.
Employee Education

It is essential that the employee understand the reason that a vision screening is being conducted. The possible explanation could be: "The identification of individuals with less than optimal vision is an important component of a comprehensive eye safety program because workers can perform most occupational activities more efficiently and safely with clear and comfortable vision" (American Optometric Association). It is also very important to educate the employee to the fact that a failed vision screening does not result in job termination.

An educated employee is the beginning of a safe employee. If the employees are trained in eye safety, the risks of a potentially vision threatening injury will dramatically decrease. All employees shall be trained in the proper use and care of safety eyewear. They will learn how to clean and inspect their eyewear daily before it is used. First Aid training for eye emergencies is an important aspect to preventing serious damage if an accident would occur. Each employee should know where the eye wash stations are located and how to use them. The eye wash stations should be easily assessable.
Two important laws, the Occupational Safety and Health Act (OSHA)\textsuperscript{7} and the Americans with Disabilities Act (ADA) have determined strict requirements, guidelines, and standards for safety eyewear and visual working conditions that all companies must meet. If these are not adhered to it can be considered negligent or reckless behavior and legal processes will occur. These can be anywhere from fines other penalties.

### Law One

**OSHA Eye and Face Protection – 1910.133**

(a)(1) The employer shall ensure that each affected employee uses appropriate eye and face protection when exposed to eye and face hazards from flying particles, molten metal, liquid chemicals, acids, or caustic liquids, chemical gases or vapors or potential injurious light radiation.

(a)(2) The employer shall ensure that each employee uses eye protection that provides side protection when there is a hazard from flying objects.

(a)(3) The employer shall ensure that each affected employee who wears prescription lenses while in operations that involve eye hazards wears eye protection that incorporates the prescription in its design, or wears eye protection that can be worn over the prescription lenses without disturbing the position of the prescription eyewear or the protective lenses.

(a)(4) Eye and face PPE (personal protective equipment) shall be distinctly marked to facilitate identification of the manufacturer.

(a)(5) The employer shall ensure that each affected employee uses equipment with filter lenses that have a shade number appropriate for the work being performed for protection from injurious radiation.
OSHA references the American National Standards Institute (ANSI). ANSI Z87 is the industrial and educational safety eyewear section. More specifically Z87.1 – 2003 says that the safety eyewear must adequately protect, be reasonably comfortable, must fit well and not interfere with the person's movement. It must also be durable, cleanable, and disinfectable. This standard is designed to protect against the following hazards:

1. Flying objects
2. Glare or excessive radiation
3. Hazardous liquids
4. Injurious radiation

According to ANSI safety eyewear could be in the form of spectacles, face shields, goggles, welding helmet's/hand shields, or special purpose lenses. However before a company selects any of the above eye wear protection they must first verify that all lenses and frames are marked with Z87 to fall under the OSHA requirements.

Referencing NIOSH, OSHA standards for companies are as follows: (www.cdc.gov/niosh/eyesafe.html)

**Safety Glasses—minimum required**

1. Use safety glasses for general working conditions where there may be minor dust, chips, or flying particles.
2. Use safety glasses with side protection such as side shields or wrap-around style.
3. Use safety glasses treated for anti-fog.
4. Use an eyewear retainer to keep the glasses tight to the face or hanging from the neck if not in use.
Goggles—better protection

1. Use goggles for higher impact protection, greater dust, chemical splash, and welding light protection.
2. Goggles for splash or fine dust protection should have indirect venting. Use direct vented goggles for less fogging when working with large particles.
3. Safety goggles designed after ski type goggles with high airflow minimize fogging while providing better particle and splash protection.

Hybrid safety glasses/goggles—better protection

1. Safety glasses with foam or rubber around lens provide better protection from dust and flying particles than conventional safety glasses with only side shields.
2. Wrap-around safety glasses that convert to goggles with a soft plastic/rubber face seal may offer better peripheral vision than conventional goggles.

Respirators—Full face & half-mask

1. Full-face respirators provide the best general dust, chemical and smoke protection (respirators may not be Z87 compliant for impact protection).
2. When half-face respirators are used, respirator must not interfere with the proper positioning of the eye protection.
Face Shields—Additional protection

1. Use face shields for highest impact, full-face protection for spraying, chipping, grinding, and critical chemical or blood borne hazards.
2. Face shields may be tinted or metal coated for heat and splatter protection.
3. The curve of the face shield will direct particles or chemicals coming from the side into the eyes. **Always wear safety glasses or goggles under a face shield.**

![Face shield with crown protector](image)

Welding

1. Exposure to welding light causes severe burns to the eye and surrounding tissue — "welder's flash."
2. Lens for welding light protection must be marked with the "Shade Number" (1.5-14, 14 = darkest).
3. Protect the eyes even when the helmet is lifted up.
4. Protect the welder, welder's helper, and bystanders.

![Welder with helmet](image)

**Use the darkest shade possible**

- Torch soldering: 1.5-3
- Torch brazing/cutting: 3-6
- Gas welding: 4-8
- Electric arc welding: 10-14

**Use Z136 eye protection for laser light hazards (NOT Z87)**
Prescription Safety Glasses

1. Workers who wear prescription glasses should wear tight fitting goggles over normal street wear glasses or contact lenses.
2. Goggles should also be worn over prescription safety glasses in high dust environments.
   If worn alone, prescription safety glasses must have side shields.
3. Prescription safety lenses with tempered glass or acrylic plastic lenses are not suitable for high impact. These types of safety glasses should not be used when working in debris areas unless covered by goggles or face shield.
4. Polycarbonate or Trivex® lenses should be used when working in high impact areas. New safety glasses with polycarbonate lenses should be hard-coated to reduce scratching.
   Contact lenses may present a significant corneal abrasion risk when working in dusty areas unless tight fitting goggles or a full-face respirator are worn.
5. Full-face respirators will not seal properly over street wear glasses or safety glasses. Prescription inserts compatible with a respirator should be used.
   Respirators should be professionally fitted.

OSHA also provides standards for labeling, signs, record keeping, communication with employees, and confidentiality regarding the application of all the above protections.

Law Two

According to the American Optometric Association (AOA) the ADA states: "General Rule: No covered entity shall discriminate against a qualified individual with a disability because of the disability of such individual in regards to job application procedures, the hiring, advancement, or discharge of employees, employee compensation, job training, and other terms, conditions and privileges of employment." Discrimination includes in part "utilizing standards, criteria, or methods of administration that have the effect of discrimination at the basis of disability." It also includes "using qualifications, standards, employment tests, or other selection criteria to screen out or tend to screen out an individual with a disability unless the standard test or other selected criteria is shown to be job related for the position in question and is consistent with business necessity."

The American Disabilities Act (ADA) defines disability to mean:

1. A physical or mental impairment that substantially limits one or more of the major life activities of such an individual
2. A record of such impairment, or
3. Being regarded as having such an impairment.
As mentioned previously it is important that all employees be educated on the appropriate procedures in case of an eye emergency. It should be recognized that different types of injuries require different responses.

**Specks in the Eye**

It is important to not rub the eye in the case of any foreign object being in the eye. The employee should be aware of the location of the eyewash and know how to use it. The eye should be flushed vigorously. If the object does not wash out and the employee still is experiencing redness and pain they should see an eye care practitioner as soon as possible.

**Cuts, Punctures, Objects Stuck in the Eye**

If any of these instances occur do not wash out the eye. If there is an object stuck in the eye DO NOT try to remove the object from the eye. Each employee should be trained on how to stabilize the eye with a shield such as a paper cup so nothing can increase the pressure or damage. The patient should see a doctor immediately. This is considered an ocular emergency.

**Chemical Burns**

According to Prevent Blindness America immediately flush eye with water or any drinkable liquid. Open the eye as wide as possible. Continue flushing for at least 15 minutes. For caustic or basic solutions continue flushing while in route to doctor. See a doctor immediately!

**Blows to the Eye**

Immediately apply cold compresses to the effected eye. Be careful to not apply pressure. See a doctor if continued pain, reduced vision, blood or discoloration of the eye occur. These can all indicate internal eye damage.
Lighting Recommendations

When working with many small, intricate details it is essential that the illumination be adequate at the workstation to facilitate optimal contrast, color, and accuracy. An appropriate evaluation of lighting conditions for all working areas should be conducted to ensure proper visual needs are met. According to the AOA², in each work area the light levels should be compared to those listed for specific tasks in the IES Lighting Handbook. It is important to note that light levels should be tested with and without the worker in position. With the worker in place sometimes light levels can be reduced by a shadow. Quality of light assessment involves looking for sources of glare, shadows, and evaluating color specification of the lighting systems.
Computer Recommendations

Many studies have been conducted on the use of computer screens in relation to eyestrain. The light level of computer screens can be adjusted to minimize eyestrain. A study performed by OSHA says that 3 out of 4 computer users complain of headaches and eyestrains. This can often be prevented by appropriate eye correction or ergonomic alterations to the environment the employee is working in.
Health Recommendations

It is recommended for all people to have biannual health evaluations of their eyes to ensure proper function and absence of disease. If any portion of the yearly company vision screening is failed an employee should follow the recommendations of the eye care provider. Most often these require a simple update in corrective lenses, however occasionally more serious complications require more extensive intervention.

ANSI provides recommendations as to health. ANSI Z89 is the industrial recommendations for health. Your eye care practitioner who conducts the industrial survey will be aware of these standards and be able to direct to appropriate actions if any are warranted.
Visual Acuity and Color Vision Recommendations

Within the screening we conducted for BIAMP emphasis was placed on visual acuity and color vision because of the specific visual demands required. BIAMP workers must be efficient in both color and the ability to see fine details.

Recommendations for visual acuity requirements are based on the amount of visual detail that is required for specific tasks at certain distances. According to the AOA an employee using 20/40 visual acuity is appropriate for coarse detail, 20/30 for medium detail, and 20/25 for fine detail.

A strict color vision standard has the most potential for eliminating individuals from consideration for specific task assignments. The D15 test, which we used, is best when determining moderate levels of color discrimination deficiency. There is no set standard, however for specific tasks that require color discrimination they must pass the D15 test.

When assessing which tasks to assign to which workers the above information may aid in making those decisions. Also, when hiring new employees for certain tasks a visual screening may be appropriate to determine their potential position within the company.

ANSI does give regulations for every-day eyewear as well as safety eyewear. ANSI Z80 is the prescription and non-prescription lenses, dress frames, rigid and soft CL and solutions and low vision aids standard. It is important that all employees who use any of the above correction, are wearing correction that has passed this standard.
Regular Vision Screenings

As a result of all of the above recommendations we suggest a yearly screening for companies such as BIAMP with intense visual needs. Such screenings aid in placing employees in appropriate positions, increase productivity, decrease errors in production, prevent injury, and increase employee/employer relations. These are also an excellent screening for the employees' general eye and body health. Pacific University offers these services to companies and is more then willing to provide any additional information or service to ensure the safety and welfare of BIAMP and its employees.
References


3. Oakland, Kenneth O.D., Clinical Dean, Pacific University College of Optometry


10. Rabin., Jeff O.D. PhD, Pacific University College of Optometry

11. Reichow, Alan O.D., Pacific University College of Optometry

12. Smith, Dennis O.D., Pacific University College of Optometry
Appendix

Appendix A ................................................................. Intake form
Appendix B ................................................................. Exam form
Appendix C ................................................................. Criteria for Referral
VISION AND GENERAL HEALTH PRELIMINARY HISTORY FORM

Patient Name ________________________________________________________________

Date ____________________ Date of Birth ____________________

Thank you for taking the time to carefully complete this form. Your answers to these questions help us to develop a clear picture of your visual and general health conditions.

EYE HEALTH AND VISION INFORMATION

VISUAL CONCERNS

What is your primary visual concern today? ______________________

Do you currently wear glasses? o Yes o No o Yes, but not all the time

Do you currently wear contact lenses? o Yes o No o Yes, but not all the time

When was your last vision examination? Clinic or Doctor's name?

Do you have (or have you ever had) any of the following eye or vision problems? (Circle any or all that apply)

- Blurred vision
- Red eyes
- Dizziness
- Eye injuries
- Double vision
- Tired or irritated eyes
- Cataracts
- Eye infections
- Headaches
- Dry eyes
- Glaucoma
- Eye surgeries
- Floaters in vision
- Flashes of light
- Macular degeneration
- Motion sickness

Other eye or vision problems: __________________________________________________

HOW DO YOU USE YOUR EYES?

What is your occupation (specific work area)? _____________________________________

Describe your specific duties while on the job. ______________________________________

How would you say you use your eyes the most during your average work day?

How many hours are you using a computer per day?

Please circle any of the following tasks and activities in which you participate outside of work.

- Reading
- Sales
- Carpentry
- Boating
- Basketball
- Computer use
- Logging
- Music
- Fishing
- Swimming
- Teaching
- Mechanic
- Gardening
- Hunting
- Bowling
- Homemaking
- Welding
- Sewing
- Tennis
- Football
- Television
- Office work
- Arts and crafts
- Golf
- Baseball
- Driving
- Public speaking
- Skiing
- Racquetball
- Activities in the sunshine

Please turn this page over and complete the other side
MEDICAL INFORMATION
Do you currently take any medications (prescription or "Over the Counter")? o Yes o No
Please list: _______________________

Do you have allergies to any medications? o Yes o No
Please list: _______________________

Do you have any other allergies? o Yes o No
Please list: _______________________

Are you currently pregnant or nursing? o Yes o No

When was your last medical examination? Clinic or Doctor's name?

Do you have (or have you ever had) any of the following medical conditions? (Circle any or all that apply)

High blood pressure o Yes o No o Unknown
Diabetes o Yes o No o Unknown
Asthma o Yes o No o Unknown
Kidney problems o Yes o No o Unknown
High cholesterol level o Yes o No o Unknown
Thyroid conditions o Yes o No o Unknown
AIDS o Yes o No o Unknown
Liver problems o Yes o No o Unknown
Heart problems o Yes o No o Unknown
Sinus problems o Yes o No o Unknown
Stomach problems o Yes o No o Unknown
Kidney problems o Yes o No o Unknown
Liver problems o Yes o No o Unknown
Cancer o Yes o No o Unknown

Other medical conditions: _______________________

FAMILY HISTORY
Many vision and general health problems tend to run in families. Please indicate below if you have family members with any of the following problems.

<table>
<thead>
<tr>
<th>Condition</th>
<th>o Yes</th>
<th>o No</th>
<th>o Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High blood pressure</td>
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<td></td>
<td></td>
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<tr>
<td>Heart Problems</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Thyroid Problems</td>
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<td></td>
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<tr>
<td>Cancer</td>
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<td></td>
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<tr>
<td>Glaucoma</td>
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<td></td>
<td></td>
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<tr>
<td>Cataracts</td>
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<td></td>
<td></td>
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<tr>
<td>Macular degeneration</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Crossed eyes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amblyopia ('lazy eye')</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Other Conditions</td>
<td></td>
<td></td>
<td>(Please Describe)</td>
</tr>
</tbody>
</table>

Relationship to you?

I understand that BIAMP has provided the vision screenings and they will be provided with results of the visual screenings. However, BIAMP will not be provided with the medical information that is listed on this form. I agree to allow BIAMP and Pacific University to use this information and the data from the visual screening for analysis and further visual recommendations.

Patient Signature: ______________________ Date: ______________________
Atending Doctor Signature: ______________________

Please bring any safety eyewear used while you are working to your screening appointment. Thank-you!

Appendix A
The above named person participated in a vision screening by Pacific University at the request of BIAMP. Screening results and appropriate recommendations are listed below. This screening evaluated ocular health and visual skills considered to be necessary for functions related to the work of employees at BIAMP. Failure noted in any of the criteria below indicates a potential need for further comprehensive evaluation by a licensed professional. This screening is **NOT** a complete visual exam and does not guarantee that an individual is free from visual disease or dysfunction. Vision changes may occur rapidly; yearly exams are recommended.

### History
- **Chief Visual concern:**
- **Last Eye Exam:**
- **Last Medical Exam:**
- **Glasses/Contact Lenses:** Far/Near

### Visual Acuity

<table>
<thead>
<tr>
<th>Criteria Not Met</th>
<th>Autorefraction</th>
<th>Criteria Not Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snellen Far: OD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumbling E OS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near: OD</td>
<td></td>
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<tr>
<td>OS</td>
<td></td>
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<tr>
<td>OU</td>
<td></td>
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</tbody>
</table>

### Cover Test
- Far: ortho/eso/exo/hyper phoria/tropia
- Near: ortho/eso/exo/hyper phoria/tropia

### Eye Movements
- **EOMs**
- **NPC** Break
- **Recovery**
- **Stereo** Test: Lang Butterfly
- Fly Random Dot Wirt
- **Accommodative Facility**
- **Vergence Facility**
- **Donders**

### Screening Summary

### PASS
- All test criteria have been met or exceeded and the individual will likely experience no visual difficulty for the present.

### FAIL
- A comprehensive visual examination by a professional eye care practitioner is indicated.
- A comprehensive physical examination by a family physician is indicated.

**Note:** If an examination is indicated, please present this form to the appropriate health care practitioner. This will assist him/her in their evaluation. We urge you to seek an eyecare practitioner who understands, tests, and treats possible visual skills deficiencies noted.

**Comments:**

---

Supervisor's Signature: ________________________________

---

### Appendix B

White Copy: Pacific
Yellow Copy: BIAMP
Pink Copy: Patient
Pacific University College of Optometry Screening Program
for BIAMP

Criteria for Referral

<table>
<thead>
<tr>
<th>1. Visual Acuities</th>
<th></th>
</tr>
</thead>
</table>
| a. Distance       | • More than 2 lines difference between the eyes
|                   | • 20/30 or poorer either eye |
| b. Near           | • 20/30 or poorer either eye |

<table>
<thead>
<tr>
<th>2. Refractive Error</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Hyperopia</td>
<td>• +1.50 D or more</td>
</tr>
<tr>
<td>b. Myopia</td>
<td>• -0.75 D or more with VA loss</td>
</tr>
<tr>
<td>c. Astigmatism</td>
<td>• 1.00 D or more</td>
</tr>
<tr>
<td>d. Anisometropia</td>
<td>• 1.00 D or more</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Binocularity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Stereoscopy</td>
<td>• 40 arc seconds or less</td>
</tr>
<tr>
<td>b. Near Point of convergence</td>
<td>• 4 inches or greater</td>
</tr>
<tr>
<td>c. Cover Test at distance</td>
<td></td>
</tr>
<tr>
<td>- Strabismus</td>
<td>• Any</td>
</tr>
<tr>
<td>- Esophoria</td>
<td>• 5 D or greater</td>
</tr>
<tr>
<td>- Exophoria</td>
<td>• 5 D or greater</td>
</tr>
<tr>
<td>- Hyperphoria</td>
<td>• 2 D or greater</td>
</tr>
<tr>
<td>d. Cover Test at near</td>
<td></td>
</tr>
<tr>
<td>- Strabismus</td>
<td>• Any</td>
</tr>
<tr>
<td>- Esophoria</td>
<td>• 5 D or greater</td>
</tr>
<tr>
<td>- Exophoria</td>
<td>• 10 D or greater</td>
</tr>
<tr>
<td>- Hyperphoria</td>
<td>• 2 D or greater</td>
</tr>
<tr>
<td>e. Accommodative facility</td>
<td>• 13 cycles/minute</td>
</tr>
<tr>
<td>f. Vergence facility</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Ocular Health</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Any verified pathology of medical anomaly of eye and/or adnexa</td>
</tr>
</tbody>
</table>