Michigan Commission on Law Enforcement Standards
Career Development Section

2024 Color Vision Standard Validation for Michigan Law Enforcement Officers

January 2024

Abstract

The State of Michigan requires all persons selected to become a law enforcement officer meet the medical selection qualifications set forth in Michigan Administrative Code Rule 28.14204. Per the licensing standards for Michigan law enforcement officers, applicants must "possess normal color vision;" however, the standard, "normal color vision" does allow for some color vision deficiency and does not require *perfect* color vision. The current color vision standard is supported by the 2018 Job Task Analysis (JTA), as well as previous JTAs, and by the essential job functions of a law enforcement officer. The Commission has the statutory responsibility to ensure the entry standards accurately reflect the contemporary position of an entry-level law enforcement officer. Accordingly, based on recent public inquiries regarding the color vision requirements, Commission staff selected the color vision standard for review. In 2022, Commission staff initiated a comprehensive review of the color vision standard, and in doing so, researched the use of color-enhancing spectacles and/or contact lenses that claim to correct color vision deficits.

The purpose of this report is to describe the process used to revalidate the Michigan law enforcement color vision standard and affirm that Michigan law enforcement applicants must meet this standard as a medical entry-level standard for all law enforcement officers in the state. The result of this review validates the current color vision standard. Commission staff concluded that no existing products, such as color-enhancing spectacles and/or contact lenses, provide the level of correction necessary to meet the color vision standard, or successfully perform essential job functions.

Background

The Michigan Commission on Law Enforcement Standards (hereafter referred to as the Commission) is authorized by Public Act 203 of 1965 as amended (hereafter referred to as the Act), to promulgate rules establishing compulsory standards for the selection, employment, and training of law enforcement officers in the state of Michigan. The diverse governing body of the Commission consists of twenty-three members who are appointed to a term of office by the Governor or by virtue of position.

In the early 1970s, the Commission (formerly known as the Michigan Law Enforcement Officer's Training Council), created the medical standards for law enforcement officers which included the existing color vision standard. The Act requires the Commission to establish standards for the employment and training of law enforcement officers. These standards include non-medical standards such as education, moral character, and recruit training, and medical standards such as physical fitness and vision.

In support of the Act, the Commission promulgated Mich. Admin. Code R. 28.14204(a)(iii) which refers to "normal color vision." The standard takes into consideration that color vision exists on a spectrum, and it was and still is entrusted upon medical professionals such as optometrists, to determine what is accepted as “normal color vision” (Mich. Admin. Code R. 28.14204).

The Commission issued the first validation report in 2009. In 2022, staff initiated a rigorous review of the color vision standard at the direction of the Commission and due to public inquiry. Additionally, this validation report addresses the use of color-enhancing spectacles and/or lenses to aid those with color vision deficiency.

Validation Process

Prior to discussing the issues and research, it is important to explain the methods and terminology utilized throughout this report. Within the context of this report, validity and validation refers to the color vision standard for law enforcement having a factual and logical basis regarding essential job functions. Data must be collected and evaluated to ensure the statewide standard meets job-relatedness. The Commission conducted Job Task Analyses (JTA) in 1979, 1996, 2006, and 2018. The JTA is a data-driven approach to identify viable essential job task functions of entry-level law enforcement officers as the profession evolves and advances over time.

2009 Validation Report

The 2006 JTA was conducted by asking 3,200 officers to rate the frequency of job tasks to determine the importance of each task. This evaluation found that officers rated the ability to accurately identify color as a highly critical job function.

The Commission staff agreed to the following guiding principles for the 2009 color vision standard validation process to ensure a quantitative and a qualitative validation process:

- Examine the essential job tasks of patrol officers in Michigan
- Consult with optometry experts and specialists
- Review of professional literature
- Explore standards used by other states and similar professions
- Examine emerging legal issues and relevant court precedent

Based on the JTA and above methodology, the optometry experts advised that those with mild color vision deficiency should be allowed to be a law enforcement officer; therefore, the Commission incorporated mild color vision deficiency as part of the color vision standard.

Lastly, court cases were evaluated for emerging legal issues and court precedent. The court cases concentrated on one issue: the color vision requirement for law enforcement officers is not a violation of the federal statute Americans with Disabilities Act. Upon completion of the 2009 validation study, staff established a valid connection between the color vision standard and the essential job functions of Michigan law enforcement officers.

2024 Validation Report

Similar to the 2009 validation report, Commission staff agreed to the following guiding principles for the 2024 validation process to ensure a quantitative and a qualitative validation process:

- Examine the essential job tasks of entry-level law enforcement officers in Michigan
- Consult with optometry experts and specialists
- Review of professional literature
- Explore standards used by other states and similar professions
- Examine emerging legal issues and relevant court precedent

The 2018 JTA process utilized the similar survey and analysis methods as the 2006 JTA. 2,940 officers were surveyed to identify core and non-core tasks. Core tasks were identified as job tasks with a "statewide significance," which included the frequency and criticality of a task as well as the task being an entry-level task.

The 2018 JTA identified 305 tasks as essential job tasks in the performance of law enforcement duties. Upon evaluation of the 305 job tasks, the Commission identified 128 tasks as being associated with color vision as part of police duties. Even though the tasks do not overtly state "recognize, or identify color," various steps and/or actions are needed to complete each of the job tasks. Some examples include:

Job Task 21: Search fire debris for evidence related to the cause of the fire.
Job Task 64: Dust, photograph, and lift latent fingerprints.
Job Task 93: Reviewing information on criminal activity in area.
Job Task 121: Observe and identify colors of automobiles, suspects' clothing, paint chips, etc.
Job Task 171: Match color of known origin to suspect sample (e.g., paint chip found at scene of accident matched to suspect vehicle)

Understanding Essential Job Tasks of a Law Enforcement Officer

The ability to accurately distinguish color is a vital part of the daily duties of law enforcement officers. While officers are routinely provided information that requires distinguishing colors of vehicles or clothing a person is wearing, officers are also called upon to perform tasks that require distinguishing color such as describing property subject to a search warrant and/or suspect descriptions involved in criminal activity. While officers are investigating cases, they must be able to provide accurate descriptions which include the color of clothing, vehicles, and injuries/trauma such as bruises or bleeding.

Lastly, color vision impacts the ability to properly collect evidence, properly identify and photograph evidence, provide detailed reports, and effectively testify in court. Color vision is vital for other important law enforcement essential job functions such as *decision-making* and *reaction time*.

Decision-Making

Color vision goes beyond being able to describe a vehicle color or clothing color on a suspect. Color vision impacts one's reaction time and depth perception which ultimately impacts one's decision-making abilities. Doug Wyllie is a well-regarded author who specializes in law enforcement training and safety. He is published in various police training magazines such as *Police*

Magazine and *Police1* and has presented at the International Law Enforcement Educators and Trainers Association conference. According to Wyllie (2013), "…judgement and decision-making are pretty much the top two cognitive capabilities a law enforcement professional must possess." Observations, information gathered at the scene, understanding of the law, are just a few elements law enforcement will use to make decisions.

Officers make split-second decisions, and the consequences can be life-altering. They rely upon the ability to combine various decision-making elements together in a condensed timeframe. A moderate or high level of color vision deficiency may result in poor decisions and tragic outcomes. For example, toy guns are often made with a colored tip. When an officer is unable to properly discern whether it is a toy or actual firearm, they may be forced to make decisions based upon incorrect information.

Public safety and potential harm can be a direct result of an officer's failure to act. The profession requires the ability to properly identify clothing, vehicles, and other descriptors in situations that involve an emergency broadcast. Emergency broadcasts are often time critical and demand accurate information for successful law enforcement resolution in cases such as:

- AMBER alerts
- Kidnapping
- Human trafficking, and/or
- Sexual assault

Decisions to apprehend a potential suspect are based on the ability to accurately identify and recognize the emergency broadcast information. For instance, an officer with red/green color vision deficiency may permit a kidnapping suspect in a red vehicle to escape because their inability to recognize the correct color of the vehicle. Likewise, it is equally problematic to mis-identify and stop individuals not involved in an investigation because of an officer's color vision deficiency.

Reaction Time

Color vision is imperative for reaction to visual presentations. According to several studies, color vision deficiency directly impacts reaction time and decision-making abilities (Barbur & Rodriguez-Carmona, 2017; Engeset et al., 2022; Lovell, 2021). In a 2011 University of Rochester study, researchers found that red directly impacts one's reactions (*Color Red Increases the Speed and Strength of Reactions*). More specifically, the study indicated that red could enhance one's responses to danger or threats. In police work, red is commonly used on emergency vehicles to respond quickly to situations that are of high risk or priority. In Michigan, officers are required to use *due caution* when exceeding the speed limit with lights and sirens. Officers must be able to quickly identify a red light at intersections and use caution prior to proceeding through the intersection (MCL 257.603).

In a 2019 study, it was discovered that athletes can be trained to increase reaction time and speed to color stimulus (Cojocariu, et al.). In another study, visual reaction time of different colored stimuli was present in those with normal color vision suggesting that color and reaction time are intimately paired (Vishteh et al., 2019). Studies on athletes have indicated that training can improve reaction time (Cojocariu, et al., 2019). However, even though someone with color vision deficiency can be trained to understand that the top light of a traffic light indicates red and to stop, the lack of distinct coloring (hues and lowered intensity of color difference) still inhibits one's reaction time. Furthermore, the nature of law enforcement work is sporadic and unpredictable; it is impossible to train for all potential scenarios to increase speed and reaction times of those who have color vision deficiency.

People with color vision deficiency can acclimate to daily driving by memorizing light placement on traffic signals. However, the chaos and stress of emergency vehicle operations through a city with many traffic signals is a good example for understanding the correlation between *normal* color vision and reaction time. The additional time it takes to process top/bottom, or right/left light configurations at every intersection dramatically increases the chances of a traffic collision happening during a high-risk activity.

Bona Fide Occupational Qualification

Being a law enforcement officer is a visually demanding occupation. Law enforcement officers are required to complete essential job function tasks with minimal to no aid from others. The profession of law enforcement requires a high level of independent function especially in critical moments. Law enforcement officers are routinely required to assess a situation and provide critical communication and feedback, often after having only visualized the situation for a matter of moments. Their ability to quickly process the defining characteristics of an article of clothing or other item, such as its size, shape, and color is a necessary skill. The Commission identified 40% of the essential job functions in the 2018 JTA as requiring *normal*[1] color-vision. Thus, the Commission has determined that the ability to meet a minimum standard of color vision is reasonably necessary to carry out the job functions of a law enforcement officer within the normal operations of a law enforcement agency.

To the extent visual acuity is protected by state and federal law, Equal Employment Opportunity laws provide for a narrow exception for a *bona fide occupational qualification* (BFOQ). A BFOQ allows an agency to consider an otherwise prohibited characteristic—such as sex, religion, national origin, or other factors—if it can demonstrate that such criteria are an essential qualification for performing a particular job function (Society of Human Resource Management, 2021). The Commission has identified that a minimum standard of color vision is essential for performing the job function of a law enforcement officer.

Issue

This review of the color vision standard addresses the validity of Michigan Administrative Code Rule 28.14204. Additionally, Commission staff researched the use of color-enhancing spectacles and/or contact lenses. The methodology for this review includes open-source information, individual contact with Commission counterparts in each state, peer reviewed journals and periodicals, federal regulations, and consultation with the Commission's subject matter experts of optometry, Doctors Mark Swan and Avesh Raghunandan from the Michigan College of Optometry

[1] See Abstract on page 2.

at Ferris State University. The research addresses current color vision tests, color-enhancing spectacles/lenes, color vision standards for law enforcement throughout the United States, the impact color vision deficiency has while performing essential law enforcement functions, and court rulings. Before starting the discussion regarding color vision deficit and correction, it is important to understand color vision and how the human eye distinguishes color.

Understanding Vision

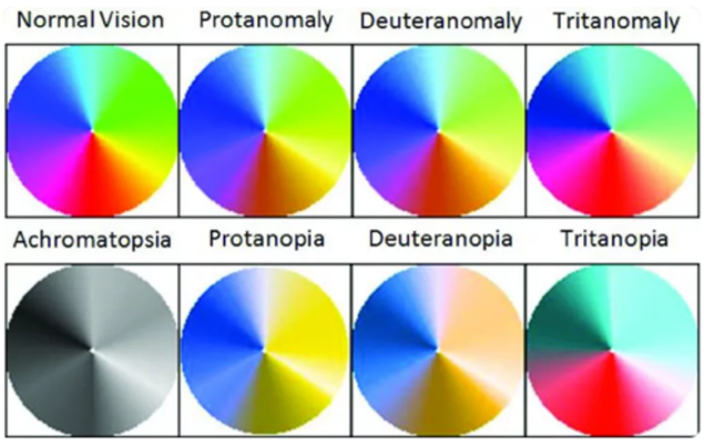
Vision begins at the level of the retina where four different photoreceptors absorb light and convert it to electrical impulses that are sent to the brain through nerve pathways (Raghunandan & Swan, 2022). Rod photoreceptors contain a photopigment that absorb the energy in wavelengths corresponding to colors within the blue-green portion of the visible spectrum and are primarily responsible for detecting low levels of light for vision in dim environments and motion detection. However, rods do not contribute to the perception of color (HyperPhysics, 2000). There are three types of cone photoreceptors based on the type of photopigment they have: L-cones are most sensitive to long wavelengths that generally correspond to colors within the red-end of the color spectrum, M-cones are most sensitive to middle wavelengths that generally correspond to colors within the green-region of the color spectrum, and S-cones are most sensitive to short wavelengths that generally correspond to colors within the blue end of the color spectrum (Lipner, 2020). The perception of different colors is based on the different balances of nerve stimulation from the cone photoreceptors. The human brain will perceive a specific color depending on the neural signature it receives from the three classes of cone cells (National Eye Institute, 2020).

Some people have a congenital condition or have a disease that causes an abnormality to the photopigments; this will cause the person to either perceive color differently or not perceive color at all (Turbert, 2022 & WebMD Editorial Contributors, 2021-a). According to the U.S. National Library of Medicine (2015), 1 in 12 males will have an inherited color vision deficiency as opposed to 1 in 200 females, with red/green deficiency being the most common inherited form of color vision deficiency. There are various types of color deficiencies:

- Deuteranomaly/deuteranopia – abnormalities or absence of the M cone pigment,
- Tritanomaly/tritanopia – abnormalities or absence of the S cone pigment,
- Protanomaly/protanopia – abnormalities or absence of the L cone pigment, and
- Achromatopsia – a condition characterized by a partial or total absence of color vision (Woods, 2021) (e.g., Figure 1).

Figure 1

Various Types of Color Vision Deficiencies



Note. The image represents the different types of color vision deficiencies. The image is reprinted from "[What does it mean to be color blind?]", by Bedinghaus, 2022, *Verywell Health*. https://www.verywellhealth.com/what-does-it-mean-to-be-color-blind-3422068

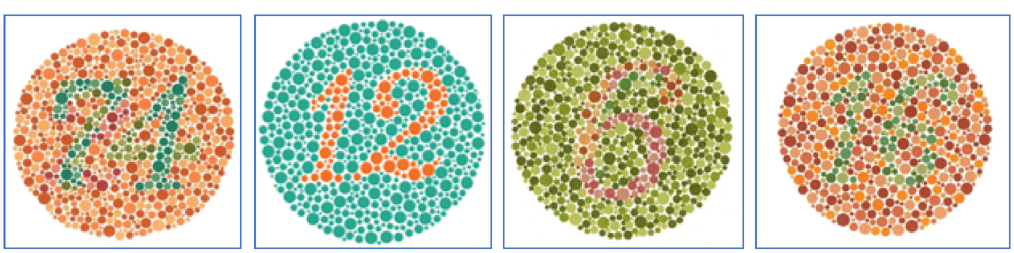
Current Color Vision Testing

Color vision tests are designed to measure a person's sensitivity to specific color wavelengths, based on the human trichromatic system (Raghunandan & Swan, 2023). If these three components are normal, then the person will have normal color perception.

Candidates applying to become a law enforcement officer in Michigan are initially screened for color vision deficiency with the Ishihara Pseudoisochromatic Plate test (PIP); this is the most used screening device to identify red-green congenital color vision deficiency (Plutino et. al, 2023). The test consists of numbers embedded in circular-colored plates consisting of colors and hues purposely chosen to be similar (e.g., Figure 2). If the individual has a color vision deficiency, they will misidentify some of the numbers. The test administration protocols are standardized and determined by the developers.

Figure 2

Ishihara Pseudoisochromatic Plate Test



Note. These images are examples of plates used during the Ishihara test. The images were adapted from "[Ishihara's Tests for Colour-Blindness (Concise edition)]", by Ishihara, S. 1985.

The PIP consists of 38 plates; however, color vision deficiency can be identified with fewer plates. The Commission requires a minimum of 14 plates to be presented and the correct identification of 10 plates. For those who do not pass the PIP test, they are sent to an optometry specialist and the PIP test is given again. Then, the Hardy-Rand Rittler Pseudoisochromatic Plate Test 4th Edition is administered.

The Hardy-Rand Rittler Pseudoisochromatic Plate Test 4th Edition (HRR) is a series of cards with colored dots that have shapes embedded. Each card has four quadrants. The examiner will ask the test taker to identify how many shapes are on each card, what the shape is, and in which quadrant(s) the shape(s) are in (*Laminated HRR Standard Pseudoisochromatic Test, 4th Edition*, 2024). If the test taker does not make any errors while reviewing the diagnostic plates, then they have normal color vision (*Laminated HRR Standard Pseudoisochromatic Test, 4th Edition*, 2024). However, if the applicant only identifies one of the shapes when there were two, the scoring will indicate which type of color deficiency the test taker has (e.g., Figure 3). The HRR test is then administered followed by the Farnsworth D-15 test.

The Farnsworth D-15 test (D-15) consists of 15 colored caps (e.g., Figure 4). The 15 colored caps comprise 15 different hues or colors that represent different locations along the color spectrum. Each hue is created by combining different ratios of the three wavelengths (S, M, & L-cones) (Raghunandan & Swan, 2023). The procedure is to have the test taker arrange the caps so that they progress along the color spectrum roughly from blue to red. The test taker is provided a starting cap and told to place the "next closest cap." This process is repeated until all the caps are arranged into a "spectrum." Test takers with normal or mild color vision deficit will arrange the caps in the normal pattern (e.g., Figure 5). Confusions occurring between color caps that are close together are not considered significant (Good Lite, n.d.).

Figure 3

HRR Pseudoisochromatic Plate Test 4th Ed.

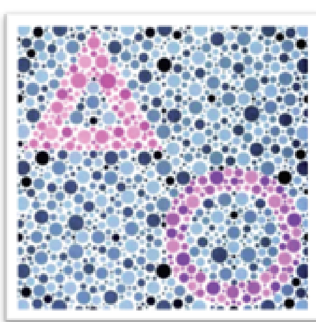


Figure 4

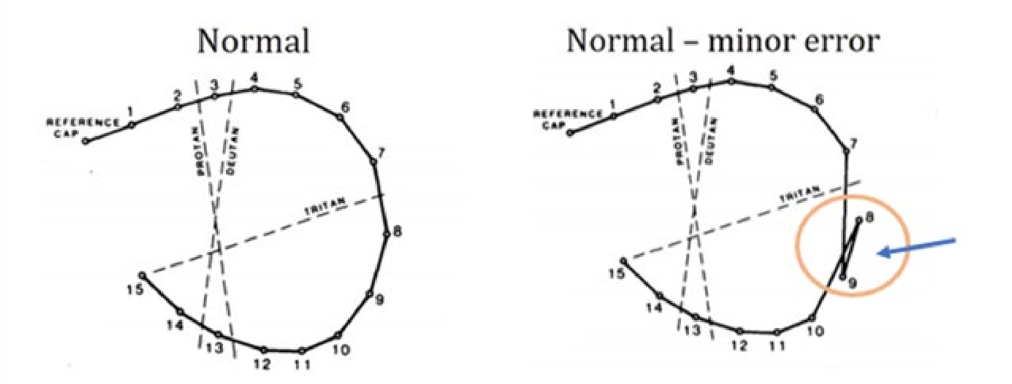
Farnsworth D-15 Test

Note. Figure 3 is plate from the HRR pseudoisochromatic plate test. The image is reprinted from "[Detection of congenital color vision deficiency by using Hardy-Rand-Rittler pseudoisochromatic test plates]" by Şekeroğlu, 2018. https://www.semanticscholar.org/paper/Detection-of-Congenital-Color-Vision-Deficiency-by-%C5%9Eekero%C4%9Flu-%C5%9Eim%C5%9Fek/84ddf9a0111f69f4b72c11d4b8b9baa80cbfa70c

Note. Figure 4 is an image of the Farnsworth D-15 test. The image is reprinted from "[Farnsworth D-15 color blind test]", by Karoly, n.d. https://www.colorlitelens.com/d15-color-blind-test-more

Figure 5

Normal[2] Color Vision

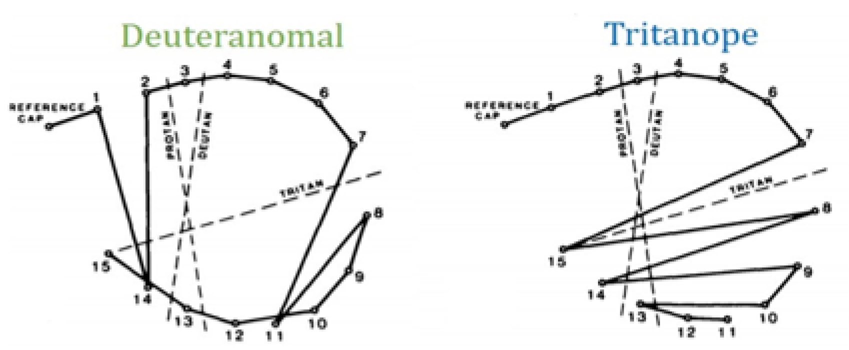


Note. The image is an example of test results of the Farnsworth D-15 whereas the test taker would most likely meet color vision standards. The is an adaptation from "[Farnsworth D-15 color blind test]", by Karoly, n.d. https://www.colorlitelens.com/d15-color-blind-test-more

Test takers with moderate and severe color vision deficits will confuse the order of certain caps (e.g., Figure 6) because their system is insensitive to one of the wavelengths and their arrangement of the caps will result in a characteristic anomalous pattern (Raghunandan & Swan, 2023). Those with normal[3] or mild color vision deficits will pass the D-15 test (Raghunandan & Swan, 2023).

Figure 6

Color Vision Deficiency



Note. The image is an example of test results of the Farnsworth D-15 whereas the test taker would most likely not meet color vision standards. The is an adaptation from "[Farnsworth D-15 color blind test]", by Karoly, n.d. https://www.colorlitelens.com/d15-color-blind-test-more

[2] See Abstract on page 2.
[3] See Abstract on page 2.

Color-Enhancing Spectacles and/or Contact Lenses

Color-enhancing spectacles and/or contact lenses are designed to alter the relative ratio of the wavelengths of light falling on the eye to change the person's perception of the color of an object or to help them discriminate the difference between two different color objects that are similar (Raghunandan & Swan, 2022). Lenses are designed by decreasing the wavelengths that are most similar and enhancing the wavelengths that are most unique for the two colors that are confused for the specific task. Color-enhancing lenses are commonly designed to use filters that primarily effect the peak wavelengths of the person's deficient color receptors. This provides a dramatic change in the appearance of the world and will allow them to differentiate the specific colors used in color vision tests. However, these filters do not provide normal perception of all colors and paradoxically will increase the confusion for tasks that involve colors in a different part of the spectrum (Raghunandan & Swan, 2022). For example, if an individual has lower sensitivity to green wavelengths the lenses will block the wavelengths in between red and green reducing the confusion of colors that are comprised of different ratios of red and green. However, if some of the red wavelength is reduced this may make new confusions of colors that are based on a ratio of red and blue (Raghunandan & Swan, 2022).

The Commission evaluated various brands of color-enhancing spectacles and/or lenses (this is not an exhaustive list), such as Colormax, ChromaGen, X-Chrom, EnChroma, and VINO. Each entity made separate claims as to what their product would accomplish. The claims were similar and are as follows:

- Colormax claims their product filters certain wavelengths of light, which will enhance the differences between two colors that would otherwise be perceived as being the same color by a color deficient individual (Colormax.org, 2022).
- EnChroma claims their "eight colored filters of a known density and color hue improves disorders such as dyslexia, color deficiency, dyspraxia, and other learning related difficulties" and "use manufacturing techniques to deliver color blind glasses that are scientifically proven to stimulate the brain's color processing center and enhance color vision for most people with red-green color blindness" (*User Manual | EnChroma Color Blind Glasses*, n.d.)
- Chou (2023) stated X-Chroma users "perceive colors differently….and whether the result is better or worse depends on personal preference and interpretation."
- VINO optics claims "...they invented and patented methods for improving our color vision, which led to technology for enhancing veins, and for correcting color blindness" (*About VINO Optics*, n.d.).

U. S. Federal Drug Administration Evaluation

The U.S. Federal Drug Administration (FDA) evaluates medical devices prior to introduction into the U.S. market; the evaluation determines the device's safety and effectiveness.[4] The FDA evaluates products based on the research and clinical trials that exist. The FDA does not conduct clinical trials of their own.

[4] The FDA review permits products to enter the U.S. market but is not an endorsement for the use of the products.

The FDA evaluated the studies on therapeutic color vision devices and found that some subjects were able to appreciate improvements; therefore, the FDA found virtually a non-existent *safety risk* and allowed for marketing (Drum, 2004). This approval was based on the idea that some subjects appreciated improvements and not that the device should be widely accepted as a cure for color vision deficiency. Therefore, the FDA required ChromaGen and ColorMax to express the limited extent of the filters and required the labeling to indicate "minimal therapeutic effectiveness" (Drum, 2004).

In 1998, ColorMax requested FDA approval of their products with labeling implying their lenses "correct" or "cured" color deficiencies and allowed patients to see "normal colors" (Drum, 2004). In 2000, ChromaGen requested FDA approval for distribution in the U.S. market as a medical device.

EnChroma lenses are FDA approved as well (*User Manual | EnChroma Color Blind Glasses*, n.d.). However, EnChroma has the following disclaimer "EnChroma does not endorse or recommend attempting to use our products to pass […] any […] color blindness test" and that they are "required per FDA labelling regulations to warn users that our glasses are not for use while driving" (Patterson et al., 2022).
X-Chrom lenses have not been included in the current FDA medical devices evaluation of risk because X-Chrom lenses were approved for medical use prior to the FDA exercising control over medical devices via the Medical Device Amendments to the Federal Food, Drug and Cosmetic Act in 1976 (Drum, 2004).

The VINO product site does not indicate that the product is FDA approved (*About VINO optics, n.d.)*.

Evaluation of Clinical Trials

Commission staff performed a literature review of the clinical trials of various color-enhancing lenses and/or spectacles. The clinical trials tested their efficacy on color vision deficiency. Studies within the last five years were selected for evaluation in order to review the most up-to-date science and data. Trials conducted on various brands of spectacles and lenses were selected to obtain a well-rounded perspective of performance of the different types and brands on the market.

VINO technology was developed in 2016 for the purpose of correcting red-green color vision deficiency (*About VINO Optics*, n.d.). However, these lenses are predominantly advertised for the medical field for enhancing the ability to recognize veins under the skin, which led to "correcting color blindness" claims (*About VINO Optics*, n.d.). In 2019, Martinez-Domingo et al. assessed the VINO filters, and its efficacy claims to correct red-green color vision deficiency. Martinez-Domingo et al. (2019) concluded that even though VINO lenses permit some subjects with color vision deficiency to pass color recognition tests like the Ishihara PIP test, users were unable to pass tests like the Farnsworth D-15 test. Negative impacts were noted such as changes in color perception and inability to pass color naming tests (Martinez-Domingo, et al., 2019).

An additional study in 2022 evaluated VINO and EnChroma products. The 2022 study concluded, "we did not find any functionally meaningful changes induced by EnChroma, and although VINO did induce a functionally meaningful reduction in thresholds, their claim that the technology 'corrects red-green color deficiency' is not supported by our data" (Patterson, et al.).

In a 2018 study conducted by Gómez-Robledo et al., EnChroma glasses were evaluated, and the study concluded that the wearer only sees colors in a different way versus new colors which means that the color deficiency still exists. However, most notably, researchers pointed out that not all color vision deficiencies are alike, and one type of filter cannot be created to correct the various types of color vision deficiency; it is not a one size fits all situation, which many of the color-enhancing spectacles/contact lens manufacturers insinuate. According to Gómez-Robledo et al. (2018) clinical trial results, "the glasses specifically used in this study have not revealed any improvement in the two types of color blindness tests: recognition and arrangement."

Bastian et al. (2020) clinical trials of EnChroma glasses concluded that even though some subjects had a change in the classification of their color vision deficiency, overall, EnChroma glasses did not improve the severity of the color vision deficiency and all participants experienced impaired color perception.

As a result of the 2022 Patterson et al., study mentioned earlier, EnChroma contacted the researchers and advised them to use the indoor glasses instead of the outdoor glasses, and then EnChroma updated their website to indicate "indoor glasses are not recommended for strong protans or strong deutans." The EnChroma user manual states their spectacles are "not certified for use in occupations where color blind individuals may be restricted for reasons of public safety, such as emergency first responders, and public transport operators" (*User Manual | EnChroma Color Blind Glasses*, n.d.).

Swarbrick et al. (2021) found that during the clinical trials of the ChromaGen contact lenses, the lens wearer had no significant effect on Farnsworth D-15 test performance. The subjects reported enhanced color perception, but poor vision in dim light, and judgement of distance and motion were only slightly affected (Swarbrick et al., 2021). "We conclude that ChromaGen lenses may enhance subjective color experience and assist in certain color-related tasks but are not indicated as an aid for color vision deficiency in occupations with color vision-related restrictions" (Swarbrick, et al., 2021).

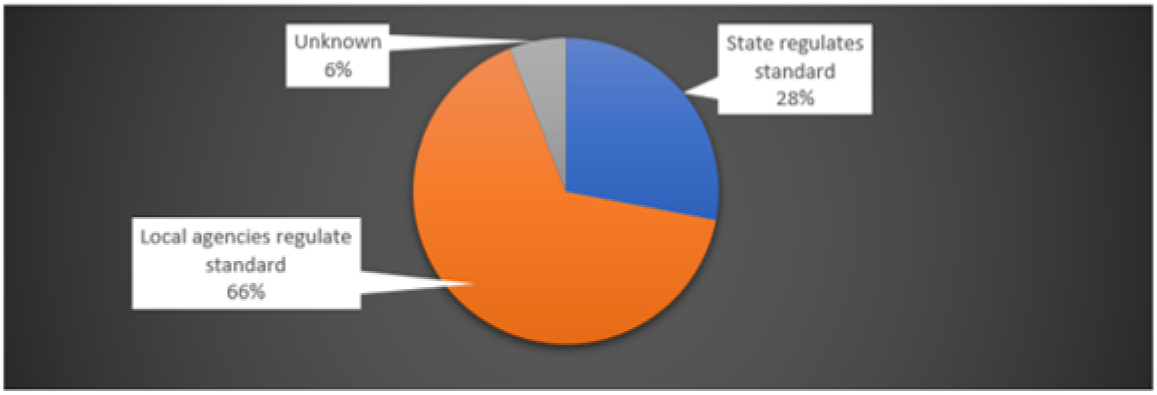
Recent studies of the X-Chrom spectacles/lenses are not in existence. In the early 1980s, several studies were conducted on X-Chrom color filtered lenses. The last finding of a study conducted on X-Chrom lenses was in 1981 and 1983. Research in the American Journal of Optometry and Physiological Optics in 1983 concluded, "the X-Chrom lens does not improve discrimination in color-deficient subjects and may alter stereopsis [depth perception]". It should be noted that X-Chrom was the product that was approved for sale in the U.S. prior to FDA regulations were in place. Therefore, X-Chrom has not withstood the scrutiny of an FDA review.

Color Vision Standards in the United States

Commission staff researched other state and city color vision standards. Of the 50 state level agencies contacted, 33 did not have a standard for color vision, 14 did, and three did not respond. However, the states that did not have a color vision standard left the establishment of a standard to local police agencies (e.g., Figure 7). This information indicates that states without a color vision standard defer to local agencies to set their requirements.

Figure 7

Regulation Body of Law Enforcement Color Vision Standards in the United States



Note. The image is a compilation gathered during MCOLES research.

Commission staff identified the largest police agencies in the United States as of 2020 according to the World Atlas (Kershner). Further research conducted by Commission staff ascertained whether color vision standards were set by a state governing body (state) or by local police agencies (local) (e.g., Figure 8). The results indicate that 16 of the 20 largest law enforcement agencies in the United States have a color vision standard.

Figure 8

The Largest Police Departments in the United States

Rank	Police Department	Full-Time Sworn Officers	State or Local Standard
1	New York (NY) Police	36,008	State
2	Chicago (IL) Police	11,965	Local
3	Los Angeles (CA) Police	9,870	State
4	Philadelphia (PA) Police	6,031	State
5	Houston (TX) Police	5,203	Local
6	Washington (DC) Metropolitan Police	3,712	None found
7	Dallas (TX) Police	3,408	Local
8	Miami-Dade (FL) Police	2,723	None found
9	Phoenix (AZ) Police	2,689	State
10	Las Vegas (NV) Metropolitan Police	2,566	Local
11	Baltimore (MD) Police	2,524	None found
12	Nassau County (NY) Police	2,462	State
13	Suffolk County (NY) Police	2,385	State
14	San Francisco (CA) Police	2,356	State
15	Detroit (MI) Police	2,250	State
16	San Antonio (TX) Police	2,244	Local
17	Boston (MA) Police	2,099	None found
18	Memphis (TN) Police	2,012	State
19	Honolulu (HI) Police	1,962	Local
20	Milwaukee (WI) Police	1,879	Local

Note. The image is a compilation gathered during MCOLES research and data from "[The Largest Police Departments in the US. World Atlas]" by Kershner, 2020. https://www.worldatlas.com/articles/the-largest-police-departments-in-the-us.html

Banned Color-Enhancing Spectacles/Contact Lenses

Commission staff conducted research by direct contact or a website search of various United States police agencies' employment qualifications regarding the use of color-enhancing spectacles/lenses for color vision testing. Many police agencies in the United States (e.g., Alaska, California, Connecticut, Delaware, Iowa, Kentucky, Nebraska, New York, etc.) disqualify applicants with a color vision deficiency and require unaided normal color vision.

Additionally, other occupations which are visually demanding and similar to law enforcement, (e.g., Pararescue, Navy Seal, Customs and Border Protection, etc.) require normal color vision acuity with unaided normal color vision (Fluck, 2007). Kosari (2022) provides an exhaustive list of occupations with "restrictions for colorblind people." The list includes Pilot, Doctor, Firefighter, Navy, Military, Electrician, Public driver, Medicine, Law Enforcement, Truck Drivers, Chef, Florist, Designer, Artist, Fashion, Graphic/Web designer, Interior designer, Painter, and Electrical, Chemical, and Mechanical Engineers (Kosari, 2022).

Court Cases

In 2004, Michigan Supreme Court, *Peden v. City of Detroit,* addressed the concept of essential job functions of law enforcement officers. Although this case does not directly mention color vision, the case specifically addresses the need for law enforcement officers to meet standards and are required to be able to comply with essential job functions identified by state law. In *Peden v. City of Detroit*, the City of Detroit dismissed Officer Allan Peden after the Detroit Police Department compiled a list of Essential Job Functions of Law Enforcement Officers that was modeled after the law enforcement governing body, the Michigan Law Enforcement Officers Training Council (now known as MCOLES).

Peden had a severe heart attack years prior and was limited to mostly clerical duties and had been in the Crime Analysis Unit at the time of his dismissal. In this case, Peden claimed a violation of the federal Americans with Disability Act 42 U.S.C. §§ 12101-12213 (ADA) and the Michigan Persons with Disabilities Civil Rights Act (MCL 37.1101 et seq). The Michigan Supreme court in *Peden v. City of Detroit* (2004) ruled:

1.) Under the ADA, Congress stated that the employer will be given the ability to make decisions as to what are essential functions of a job, and if the essential job functions were developed prior to interview, then the description would be evidence of essential functions of the job (42 USC 12111(8)).
2.) Michigan law defined the essential functions and job functions of law enforcement officers under MCL 28.601 *et seq.* now under Public Act 203 of 1965 as amended. Therefore, an essential job function list existed at the time of employment.
3.) Under the Equal Opportunity Employment Commission (EEOC), an essential job function is not limited to tasks an employee conducts on a regular basis. Rather, essentiality exists if there are a limited amount of people who can perform that function, the job position exists because of that duty, and/or the function is highly specialized.

4.) Peden held the title Police Officer and Michigan laws define the essential duties of a police officer; therefore, the City of Detroit was not in violation of ADA, EEOC or other violations by terminating Peden.

In a 2000 California case, *Diffey v. Riverside County Sheriff's Department* (the County), Teg Diffey sued the County because he was not hired as a Sheriff's Deputy because he failed both color vision tests that were administered by the County under the state of California requirements for employment. Diffey initially won his civil suit claiming discrimination due to his color vision deficiency. Upon appeal, the appellate court overturned the original ruling; the ruling was affirmed by the Supreme Court in 2001. The court in *Diffey v. Riverside County Sheriff's Department* (2000) ruled the following:

1.) Color vision deficiency is not a disability protected under the Americans with Disabilities Act (42 U.S.C. §§ 12101-12213) because it does not limit major life activities,
2.) Color vision is a bona fide occupational qualification and is an exception under Equal Employment Opportunity laws.

In a 2009 Pennsylvania case, *Lekich v. Municipal Police Officers Education Training Commission* (MPOETC), Eric Lekich sued the MPOETC because he was not hired as a police officer after he failed the color vision portion of his physical exam. Under Pennsylvania code 37 Pa. Code § 203.11, "…the applicant shall have normal depth and color perception and be free of any other significant visual abnormality." Lekich claimed that per the American with Disabilities Act (42 U.S.C. §§ 12101-12213), color vision deficiency is a disability and reasonable accommodations were necessary. The court in *Lekich v. Municipal Police Officers Education Training Commission* (2009) ruled:

1.) Lekich was not considered disabled due to his color vision deficiency under the American with Disabilities Act (42 U.S.C. §§ 12101-12213).
2.) Moreover, because Lekich was not considered disabled, he was not entitled to reasonable accommodations.

Conclusion

The lack of normal[5] color vision is a detriment to the essential job functions of law enforcement especially public safety. The law enforcement profession is a visually demanding occupation. There are many careers, in addition to law enforcement, that require color vision due to the increased safety hazard color vision deficiency poses upon the public: Air Pilot, Air Force, Pararescue, Navy Seal and Customs and Boarder Protection. Commission staff identified 40 percent of the 2018 Michigan law enforcement Job Task Analysis as requiring color vision to perform the task. A majority of states and cities within the United States require color vision as a fitness for duty standard for law enforcement.

Court precedent has clearly addressed claims of discrimination regarding the color vision standard for law enforcement officers:

[5] See Abstract on page 2.

- Color vision is a bona fide occupational qualification and is and exception under the Equal Employment Opportunity laws.
- Essential job functions clarifying job expectations, i.e., normal color vision, is not a violation of Equal Employment Opportunity laws.
- Color vision deficiency is not a disability and is exempt from Americans with Disabilities Act expectations for accommodations.

In conjunction with understanding the criticality of normal color vision and court precedent, color-enhancing spectacles and/or contact lenses are not an acceptable alternative to the normal color vision standard. Clinical trials have demonstrated the lack of efficacy offered by color-enhancing spectacles and/or contact lenses. These spectacles/lenses simply alter perception of one color to the detriment of another color.

The Swarbrick, et al. (2021) clinical trials concluded, "ChromaGen lenses may enhance subjective color experience and assist in certain color-related tasks but are not indicated as an aid for color vision deficiency in occupations with color vision-related restrictions." The EnChroma user manual specifically states their spectacles are "not certified for use in occupations where color blind individuals may be restricted for reasons of public safety, such as emergency first responders and public transport operators."

Commission staff have thoroughly evaluated the current color vision standard and testing protocols. Based on the evaluation, it is recommended that the current color vision standard must be maintained and no alterations to the standard or the testing protocols be made at this time.

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APPENDIX

2024 Color Vision Standard Validation

SUBJECT: **Color Vision Standard for Police Officers**
PURPOSE: **Commission Information**

DATE	SECTION	EXECUTIVE DIRECTOR	AUTHOR
November 22, 2022	Standards Compliance	Timothy Bourgeois	Leon Boyer

Background:

The State of Michigan requires a person selected to become a law enforcement officer meet the medical selection qualifications set forth in R 28.14204. Per the Licensing Standards for Michigan Law Enforcement Officer [6] applicants must "*Possess normal color vision without the assistance of color enhancing lenses.*" This standard is supported in the 2018 Job Task Analysis (JTA) results.[7]

The Career Development Section conducted a comprehensive review of the color vision standard and the use of color vision contact lenses. The results of the review found no products provide the level of correction needed for a law enforcement officer position.
The Career Development Section researched color vision and the use of color vision contact lenses. In 2009, the Commission reviewed and revalidated the color vision standard keeping the current standard in place.
The current standard reads:

> *"Possess normal color vision without the assistance of color enhancing lenses. The unaided eye shall be tested using pseudoisochromatic plates. The Farnsworth Dichotomous D-15 panels shall be used for any candidate who fails the pseudoisochromatic plates."*

Research was conducted into the status of a color vision standard at the state level across the country. The data collected shows that of the 50 states contacted, 33 did not have a standard for color vision, 14 did, and 3 did not respond. The states that did not have the color vision standard left the establishment of the standard to the individual agencies. MCOLES researched the 20 largest police departments across the country, according to the World Atlas. The data shows 19

[6] https://www.michigan.gov/mcoles/standard-training/licensing-standards-for-michigan-law-enforcement-officers
[7] https://www.michigan.gov/mcoles/issues-news-info/2018/12/09/2018-statewide-job-task-analysis-for-the-patrol-officer-position

of the 20 largest police departments have a color vision standard in the police officer qualifications. Anecdotal information suggests the combined state and agency standard for color vision acuity covers the vast majority of police officers across the United States.

Issues:

The Commission requested the research after remarks regarding the color vision requirements were made during public comment section of the Commission meeting held September of 2022. The Career Development Section conducted a comprehensive review of the color vision standard and the use of spectacle and contact lenses that claim to correct color vision deficits. This review was conducted in the form of open-source information, individual contact with each Commission counterparts in each state, peer reviewed journals and periodicals, federal regulations, and consultation with the Commission's subject matter experts. During the review there were several issues that were revealed. These include:

Color vision and how we see color-
Vision begins at the level of the retina where four different photoreceptors absorb light and convert it to electrical impulses that are sent to the brain through nerve pathways. Rod photoreceptors contain a photopigment that absorbs the energy in the blue-green portion of the visible spectrum and are primarily responsible for detecting low levels of light for vision in dim environments and motion detection. Rods make minimal contribution to the perception of color. Cone photoreceptors are concentrated in the macula for central vision and color perception. There are three types of cone photoreceptors based on the type of photopigment they have: L-cones are most sensitive to long wavelength red-end of the color spectrum, M-cones are most sensitive to middle wavelength green-region of the color spectrum, and S-cones are most sensitive to short wavelength blue-end of the color spectrum. Humans can perceive all of the colors of the spectrum because each "color" will stimulate each cone at different intensities. Humans perceive different colors when they receive different balances of nerve stimulation from the photoreceptors. Therefore, each color has its unique neural signature. The human brain will perceive a specific color depending on the neural signature it receives from the 3 classes of cone cells.

Some people are born with, or have a disease that causes, a deficiency or shift in sensitivity of one or more of the photopigments. This causes the relative nerve stimulus from certain colors viewed by the eye to be distorted. The person with deficient photoreceptors will perceive the color differently than people with a normal balance of photopigments. Studies also show 1 in 12 males will have some sort of inherited color vision deficiency as opposed to 1 in 200 females and 98% of inherited color vision defects involve red and green colors.

Michigan testing for police officer color vision:
The Commission uses two tests to check for color vision deficiencies. These tests are:
Ishihara Test: This test checks for total color blindness and red-green color blindness by assessing an individual's ability to perceive primary colors and shades of color. The Ishihara

book contains a series of polychromatic plates of primary-colored dots arranged to form a numeral against the background of similar dots of contrasting colors. *Farnsworth D-15 Test:* The D15 set is a modification of the well-known Farnsworth Hue Test. The D15 test is intended for classification. Each D15 set contains a reference disc and fifteen numbered discs, which make up an incomplete color circle within a standardized color space. The observer arranges the colored discs by similarity in a sequential color series. The sequence of arrangement determines whether the observer has one of the 3 types of color vision deficiency.

Color vision correcting or color altering spectacle and contact lenses:
One organization in the United States claims that their color altering spectacle and contact lenses are designed to help an individual pass a specific test for color vision impairment.[8] These lenses are custom made and claim to filter certain wavelengths of light, which will enhance the differences between two colors that would otherwise be perceived as being the same color by a color deficient individual. These lenses are touted as a cure for color vision deficiencies or used inappropriately to pass color vision tests.

Research on color altering contact lenses:

Clinical Trials
ChromaGen Contact lens: Swarbrick et al. (2001):
Lens wear had no significant effect on Farnsworth Lantern test performance. Subjectively, subjects reported enhanced color perception, but poor vision in dim light. Judgement of distance and motion were only slightly affected. We conclude that ChromaGen lenses may enhance subjective color experience and assist in certain color-related tasks but are not indicated as an aid for color vision deficiency in occupations with color vision-related restrictions.

Clinical Analysis 2021: According to Hathibelagal in 2022
An analysis of color vision and color vision lenses was conducted in patients from 2010 -2021. The individuals with color vision discrepancies were analyzed regarding color vision and the use of color altering lenses. The analysis showed that the tinted lenses did provide some enhancement of color perception when tested. The article cautioned that this came at the cost of loss of depth perception and issues related to rivalry between eyes.

U.S. Food and Drug Administration (FDA) Approval:
Research into the use of color altering lenses shows the FDA has researched the lenses. The article shows in 1998, ColorMax Lenses attempted to obtain labeling implying the lenses “correct” or “Cure” color deficiencies and allow patients to see “normal colors”. The claims had to be changed to a red-green deficiency aid. In 2000, ChromaGen contact lenses requested approval. The FDA required ChromaGen to express the limited extent of the filters. The FDA conducted a study and found that some subjects were able to appreciate improvements. With a

[8] https://colormax.org/pass-a-color-blind-test/

virtually non-existent risk the FDA allowed labeling as long as it shows minimal therapeutic effectiveness.

Key Function:

The current job task analysis consists of 305 tasks that are common for a police officer to conduct in performance of their duties. This job task analysis breaks down the duties into specifics and by group. Out of the 305 tasks there are 84 of tasks that are associated with color vision as part of your duties. As an example, Job Task #121 states as follows:

"*Observe and identify colors of automobiles, suspects' clothing, paint chips, etc.*"

Color is a bona fide occupational qualification. A Bona Fide Occupational Qualification (BFOQ) is a very narrowly interpreted exception to Equal Employment Opportunity (EEO) laws. A BFOQ allows employers to base employment decisions for a particular job on such factors as sex, religion or national origin if they are able to demonstrate that such factors are an essential qualification for performing a particular job. (Society of Human Resource Management).
In this case, the ability to see color is a BFOQ as it is a vital part of the daily duties of a police officer. A police officer routinely is dispatched to look for a certain color vehicle, person in a specific color shirt etc. or is similarly required to accurately perceive and name colors as a part of descriptions or routine, daily tasks. The citations and reports that have been reviewed provide a space to articulate the color of the vehicle. Court testimony often requires identification of color. This frequency of use and articulation in the job task analysis provide a reasonable justification for the BFOQ.

Banned Color Altering Contact Lenses:

The Federal Aviation Administration (FAA) specifically disallows the use of color-altering contact lenses like X-Chrom for passing their flight physical.[9] As another example, the California Department of Corrections and Rehabilitation disallows Peace Officers from using these color filter contact lenses to pass their color vision testing. Many other occupations that depend on the ability to distinguish color such as mariners, military security personnel, special forces operators, likewise disallow use of X-Chrom and other color filters to protect public safety.

Impact of Police Officer Reaction Time:

(According to Lovells Dissertation)
Color vision has an imperative use for individuals in occupations that require quick responses to visual presentations. Color vision is used as a visual aid in many different ways such as authorized routes on maps (snowmobile, hiking, roadways) or weather radar maps. The listed examples are a few examples where delays could be cause by the inability to perceive colors.

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[9] https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/app_process/exam_tech/item52/amd/

Police officer color vision court case:

Federal court dismisses an ADA suit brought by a police applicant who was rejected because of a color vision impairment. He was not regarded as disabled, and the lack of normal color vision is not a substantial limitation on the ability to see. Finally, he was not entitled to reasonable accommodation. Lekich v. Munic. Police Officers Educ. Training Cmsn., #08-1048, 2009 U.S. Dist. Lexis 16645, 21 AD Cases (BNA) 1409 (E.D. Pa.). Federal court concludes that color blindness is not a protected disability. Lekich v. Municipal Police Officers Educational Training Commission, #08-1048, 2009 U.S. Dist. Lexis 16645 (E.D. Pa.).

Conclusion:

The Career Development Section cautions there is a difference between using lenses to pass a color vision test and having suitable color vision to perform as a police officer. There are several areas of concern regarding the potential removal of the color vision requirement. The inability to distinguish color has the potential for serious public safety concerns, especially during low light and/or high stress situations. In addition, violations of individuals' constitutional rights, increased liability, and courtroom credibility issues may come into question as a result of failing to distinguish color.

Routine tasks such a nighttime driving or other low light operations may be impacted using these lenses. Numerous studies have demonstrated most officer involved shooting or critical incidents happen during low lights hours. Lenses that filter light may cause an officer to misidentify or completely fail to see objects is a serious safety concern.

Research substantiates that the use of color altering spectacles and contact lenses do not restore color vision, they may simply assist a person with one color spectrum while diminishing the effect of another color spectrum. The tint associated with these types of spectacles and lenses reduce visual acuity due to the light reduction.

Finally, it is important to note the Commission's current color vision standard allows for mild but not moderate or severe color vision impairment. The standard was set to avoid the significant onset of color-naming errors that begin at the moderate impairment level.

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