



seeingmachines

REPORT

EYEWEAR GUIDANCE

This document provides questions and answers around the appropriate eyewear to be able to detect fatigue.

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1. GENERAL EYEWEAR GUIDANCE

General guidance on how to wear glasses so the frames don't obscure the eye and the recommended lens that work best with the Guardian systems.

1.1 Recommended frame shapes for faces

Wear glasses that fit your face shape, which will allow for a more comfortable fit so that glasses stay positioned correctly on your face.



















































	 OVAL Proportional, with narrowing at forehead and chin	 ROUND Proportional, with length and width virtually equal	 SQUARE Proportional, longest along the forehead and jawline	 TRIANGULAR Wider forehead, narrow chin, angular cheeks	 HEART Wider forehead, narrow chin, with rounded cheeks
ROUND					
CAT EYE					
RECTANGLE					
WAYFARE					
SQUARE					
AVIATORS					
GEOMETRIC					
BROWLINE					
OVAL					

Figure 1: Recommended frame shape for different face shapes.

1.2 What lenses work best with Guardian

Guardian works best with lenses that have an infra-red (IR) transmission greater than 50% and a reflectance at 940nm, as more light can pass through the material, which allows the system to have a greater ability of detecting the eye.

The Guardian system must be able to detect the eye, or an alert will be created.

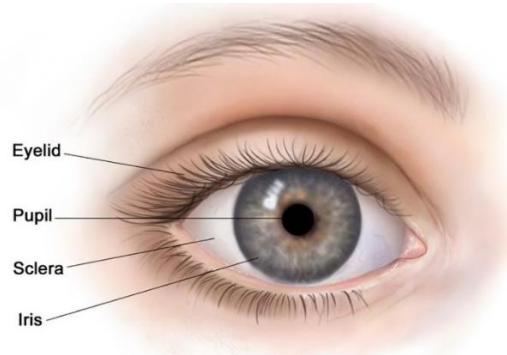


Figure 3: The Eye consists of: Eyelid, Pupil, Sclera & Iris.

The reason why selecting a lens with greater IR transmission is because more light can pass through the material onto the other side allowing the eye to be seen. Its commonly found that lenses that reflect or block IR cause false alerts as light can't pass through the lens reflecting unrelated images back to the system, as seen in the images below.



Figure 4: These are images where Guardian cannot track and see the eyes because lens transmissivity less than 50%

Wearing polarized glasses have no impact on the system, as seen in the images in figure 5, eyes are able to be seen through the lenses.



Figure 5: These are images where Guardian can track and see the eyes because lens transmissivity is greater than 50%.

1.3 How to avoid frames from obscuring the eyes

A common false alert is created because glass frames can obscure the eye, below is some recommend 6-point tips that will help avoid the eye from being obscured



1: Your pupils should be centred within the lenses



2: The glasses shouldn't extend past the sides of your face



3: The lenses shouldn't rest below your eyebrows



4: When you smile the frames should stay in place



5: The glasses shouldn't slide down your nose



6: The temple tips should sit comfortable on your eye



Figure 6: Guardian cannot detect the eyes because the frames are obscuring them

1.4 Sunglasses Test – Compatibility of eyewear to Guardian

It is possible to test sunglasses by using handheld devices that measure IR transmittance and reflectance at 940nm. The target is a transmittance of greater than 50% and reflectance of less than 20%. This can be done locally in field with an array of devices such as the following:

BRAND	MODEL
Qualtech Products	QPI-LTM1800
Qualtech Products	QPI-RMUSB180
LiebeWH	LiebeWHei0q5xgpa83991
LEXEN	LS163A

Table 1: Examples of devices that can measure either IR Transmittance or Reflectance

Please note: *Seeing Machines does not endorse any particular devices to be used for testing and the devices listed above are intended to be examples only. Furthermore, Seeing Machine only recommends this as a guidance test method due to environmental or other external testing factors that impact testing results. To submit your glasses for further testing by our Optics team, please contact your Account Manager or customer support.*

2. EXTERNAL FACTORS THAT CAN AFFECT EYE VISIBILITY

Guardian Gen1 has seen more issues around external factors than Guardian Gen2 this is because of Gen2's sophisticated algorithm and processing ability. Seeing Machines is dedicated to continuous discovery and technology development that addresses the external factors affecting eye visibility, so fatigue intervention can be detected as soon as possible.

2.1 Sunlight

Glare can be varying depending on the environment and time of day. As seen in Figure 7, the bright environment reflects onto the glasses. If the reflections are too strong, the eyes cannot be seen and cannot be tracked by Guardian.



Figure 7: Showing how glare can affect the detection of eyes

To increase the availability of eye tracking in bright light conditions, Guardian Gen2 uses an Infrared (IR) illumination and filter combination that results in Figure 8: Right, under the same bright light condition as Figure 8: Left. The IR filter is used to maximize different lighting conditions during the day or night.

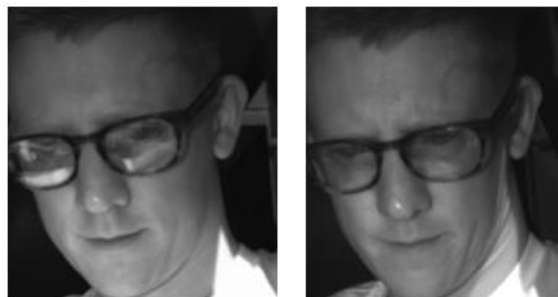


Figure 8: Left: Unprocessed image of Sunlight reflecting on eyewear.
Right: Processed Image from Guardian Gen2

While images can be filtered, it is recommended to use sun visors in extremely bright conditions. This is because strong reflections on the glasses can bounce back to the camera causing a brief time delay in re-adjustments for camera focus.

2.2 Specular reflections

Infrared light from the Guardian system can reflect onto the glass lenses at any time of the day or night. This is not harmful to the driver, as they are non-ionizing wavelengths, falling into the category of TV Remotes.

The reflections appear as white spots seen in Figure 9. At times, the reflections can obscure the eye, causing a false detection.



Figure 9: Specular reflections appear at different locations (or not at all) depending on the head pose

Gen2 is designed to minimize the overlap of reflection spots, hence increasing the availability of eye tracking.

2.2 In-Cab Sensor Module Setup

It's important that the In-Cab Sensor (ICS) is fitted properly according to the [Gen 2 Field support Installation Manual](#) (page 28), as it houses the driver facing camera.

The ICS must have a clear view of the drivers face whilst not creating blind spots for the driver.



Figure 10: In-Cab Sensor Module

3. FATIGUE SYMPTOMS & INTERVENTION

Guardian is not a system that should be used as a first point of call for fatigue intervention, drivers and management need take responsibility for their safety by being aware of what fatigue symptoms are, so early intervention can happen.

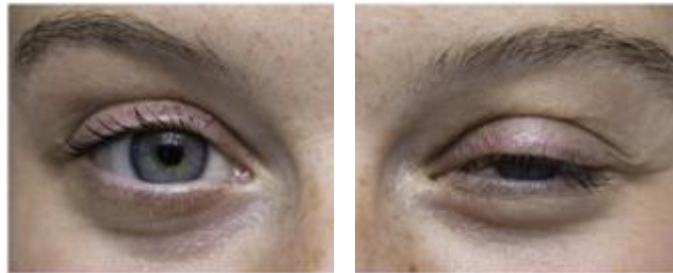


Figure 11: Left: Eye is fully open, no sign of fatigue
Right: Eye is partially closed, sign of fatigue

3.1 Yawning

Detected when the driver's eyes close because of a yawn. The driver's mouth is open (due to the yawn), and their eyes may be fully or partially closed.

3.2 Drowsiness

The driver's eyes appear to be heavy and eye closures are dramatically slower or more rapid. A key indicator is the continuous closures where the driver appears to be fighting the onset of fatigue.

3.3 Microsleep

The driver appears to be in a state of sleep. Key indicators include uncontrolled eye closure, eye rolls, long eye closures, and head bobs where the driver has lost control of their neck muscles.

3.4 Truck Drivers Management Intervention Plan

According to [Truck Driver Fatigue and Management](#), fatigue is common issue that truck drivers must deal with regularly. To deal with the obstacle, it is necessary to follow the workplace procedures and protocols in a disciplined manner. The employers of truck drivers need to play a responsible role and make sure that the health and safety of the drivers and others are not compromised. As a truck driver, you also need to make sure that you follow the organisational policies and procedures relating to health and safety in the work setting. If you constantly are

experiencing fatigue while driving for long hours, its necessary to have a system in place to help raise awareness and continually manage and monitor drivers.

3.5 Guardian Intervention Plan

Guardian uses advanced algorithms to detect when a driver is fatigued. Fatigue events are determined by the duration of the driver's eye closure. Guardian Gen 2 has sophisticated algorithms which can help to detect classification of events, which are relayed back to the user to help intervene in late-stage dangerous situations.

4. GLASSES NOT RECOMMENDED

Guardian by Seeing Machines operates using near-infrared LEDs, centred on wavelengths at 850nm and 940nm. These wavelengths allow driver illumination using a non-visible portion of the light spectrum to avoid distracting the driver, while providing the system with a clear image. From previous testings, the below table is a guide of various glasses and brand which we don't recommend with the Guardian System.

Please note: *Seeing Machines does not endorse any safety glass brands or suppliers. Independent testing has been conducted on a large range of glasses purchased for testing or supplied to Seeing Machines by customers. The following is a non-exhaustive list of glasses that have been tested by Seeing Machines and confirmed not to be suitable for use with the Guardian.*

BRAND	MODEL
ACES	2668-35AF Brown Spectacles (indoor/outdoor), Anti-fog
ACES	2668-15AF Cool Spectacles (Indoor/Outdoor), Anti-fog
BLUE RAPTA	Slide Smoke lens
BLUE RAPTA	Switch Smoke lens
BOLLE	Bandido Safety Glasses Smoke
BOLLE	Blade Light Smoke S/Flash HC
BOLLE	Blade Safety Glasses Smoke
BOLLE	Blade Smoke HC/AF
BOLLE	HUSTLER POLARIZED Lens Safety Glasses
BOLLE	Prism Smoke AS/AF
BOLLE	Prism Smoke 1614402
BOLLE	Prism Bronze/Smoke 1614402
BOLLE	Prism Safety Glasses Smoke
BOLLE	Prowler Safety Glasses Smoke
BOLLE	Prowler Smoke lens
BOLLE	Sidewind Safety Glasses Smoke
BOLLE	Sidewind Smoke lens

BOLLE	Rush Plus Safety Glasses Smoke
HAWKERS	Cole, Light Blue and Purple Mirrored
MACK	DUO ME524
MSA	Arctic Gold Light Gold Mirror
MSA	Discovery Lite Gold
MSA	Discovery Smoke
NASCAR	GT I/O Mirror Lens Safety Glasses
PRISM LIGHT	1614403 Silver Lens Safety Glasses
PROCHOICE	Tsunami Smoke Medium Impact
PROSAFE	Peregrine
RAY-BAN	Aviator Gradient Model: RB3025 004/51 55-14
RAY-BAN	Wayfarer Folding Remix
SAFETY WHIM CREEK	S76T Brown Lens Safety Glasses
SIDEWINDER	1615501 Clear Lens Safety Glasses
SIDEWINDER	1615502 Smoke Lens Safety Glasses
UVEX	Pheos Grey lens
UVEX	SONIC SIL LIR BK FR SN881
UVEX	SONIC SIL LIR BK FR SN085
UVEX	SONIC SIL LIR BK FR SN185
UVEX	Honeywell s3201D Espresso tinted lens-treated with Dura-steam lens coating
YUKON	WRAPAROUND AS9800 Clear Lens Safety Glasses

Table 2: Brand and Model of glasses not recommended for use with the Guardian System