

SOBEREYE PLR Technology

Evaluating Impairment Risk due to Alcohol, Drugs and Fatigue

SOBEREYE Pupillary Light Reflex (PLR) Measurements

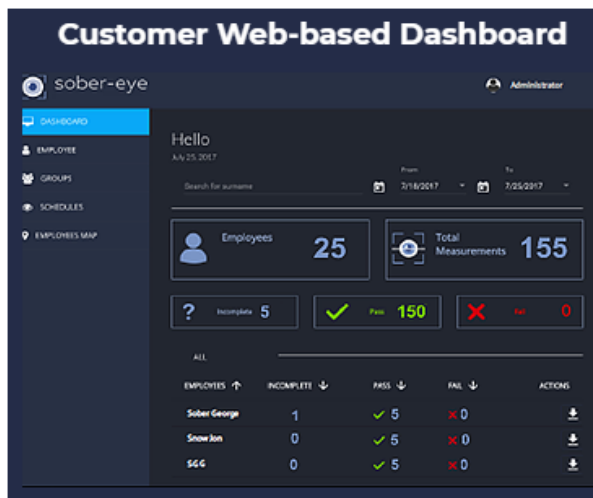
Current systems that measure the level of blood alcohol concentration, presence of drugs, or indicate fatigue each focus on a specific area. They do not measure impairment and they do not measure the effects of combining alcohol and drugs or fatigue with alcohol and/or drugs.

PLR is an involuntary reflex that controls the eye's pupil in response to changing light intensity. Consumption of alcohol, drugs or fatigue can result in changes in PLR. Measuring PLR can be used to evaluate impairment risk regardless of whether impairment is due to a single source or a combination of sources.

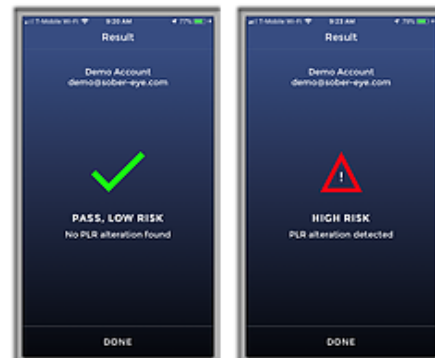
The first PLR workplace measurement systems were benchtop systems. Leveraging advances in video technology and processing capability, SOBEREYE developed the first smartphone-based PLR measurement system. The SOBEREYE smartphone system captures high resolution video, analyzes the video, and compares PLR measurements to an individual's baseline PLR (normal, unimpaired PLR). Iris recognition automatically verifies the user's identity enabling the system to be used remotely without supervision. A software dashboard controls testing schedules. Results are displayed on the smartphone and the software dashboard. The SOBEREYE system provides a quick way to evaluate impairment risk.



Customer Web-based Dashboard



Smartphone Results

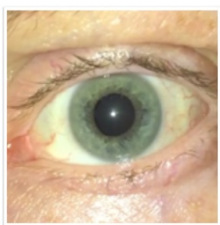


The SOBEREYE system was evaluated independently to determine the system's ability to accurately measure PLR. ^{1,2,3} These reviews included measurements of test subjects, evaluation of SOBEREYE's PLR measurement technology (video measurement and processing), and SOBEREYE's statistical analysis and scoring approach. The results show that SOBEREYE's system delivers high quality PLR measurements and provides a reliable system to identify impairment risk and improve workplace safety.

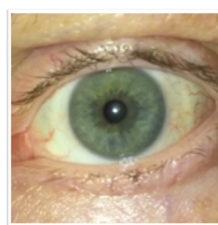
Pupillary Light Reflex Technology Background

PLR has been used for many years by law enforcement to indicate impairment, by medical facilities to evaluate neurological conditions, and by commercial companies in fitness-for-duty applications for workplace safety.

Pupil constriction and dilation are controlled by the autonomic nervous system which regulates bodily functions such as PLR, heart rate, respiratory rate, and digestion without conscious control. PLR is an involuntary reflex that controls the eye's pupil in response to changing light intensity. Approximately 30 percent of the brain is dedicated to visual processing. Changes in brain function due to alcohol, drugs or fatigue can result in changes in PLR. PLR analysis is a non-invasive method to evaluate nervous system function.



Pupil in Dim Light

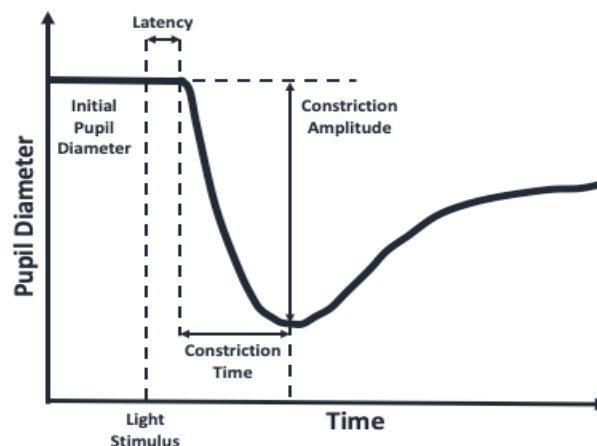


Pupil in Bright Light

Measuring PLR can be used to identify a potential risk of impairment. However, while a PLR change can indicate an impairment risk, it does not identify the specific source of the impairment (alcohol, drugs, fatigue, and neurological conditions). Unlike a drug test which can result in legal issues, the PLR check focusses on workplace safety and this helps with workforce acceptance.

PLR is measured by evaluating four parameters:

- Initial Pupil Diameter (IPD)
- Latency (L)
- Constriction Velocity (CV)
- Constriction Amplitude (CA)



Normal PLR Variation and the Importance of a Baseline

Normal PLR varies from person to person and an individual's PLR can change over time. Measurements made by law enforcement or patients admitted to a hospital compare measured results to the average of the general population's normal unimpaired PLR. SOBEREYE establishes a PLR baseline (normal, unimpaired PLR) for each person under controlled light conditions. New PLR measurements are evaluated against the individual's baseline. This enables SOBEREYE to provide more accurate, reliable results than traditional approaches.

The table below is from three studies that evaluated PLR of healthy, unimpaired individuals.^{4, 5, 6} Studies tested subjects for Initial Pupil Diameter (IPD), Latency (L), Constriction Velocity (CV) and Constriction Amplitude (CA). The table below shows mean and standard deviation for each PLR parameter. One standard deviation represents about 68% of the people tested. The variation in PLR parameters, particularly IPD, CV and CA, is the reason SOBEREYE establishes a PLR baseline for each individual.

PLR Element	Mean	Standard Deviation	Standard Deviation Range (± % around mean)
Initial Pupil Diameter (IPD) ⁴			
Room light	3.86 mm	0.93 mm	±12.0%
Near-total darkness	6.41 mm	1.55 mm	±12.1%
Direct light	3.35 mm	0.72 mm	±10.7%
Latency (L) ⁵ :			
60Hz	0.982 ms	0.012 ms	±1.2%
300Hz	0.981 ms	0.014 ms	±1.4%
Contraction Speed (CV) ⁶	5.65 mm/s	1.17 mm/s	±10.4%
Change in Amplitude (CA) ⁶	1.92 mm	0.39 mm	±10.2%

Some types of eyewear may interfere with PLR measurements. Colored contact lenses, for example, usually contain a transparent center for the pupil. The transparent center varies in size and in some cases can obscure the pupil and change the observed PLR.⁷ SOBEREYE can provide guidelines for best practices to identify and, in some cases, avoid this interference.

References

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