

Microscopes - Eight Ways the Exit Pupil Can Affect Operator Performance and Productivity

When working with microscopes, everything that comes before and after the exit pupil can significantly affect quality and productivity. So, what is the exit pupil and how can it have so much control over production outcomes?

The circle of light

A person's eyes and a stereo microscope both have pupils. For the eye it's an entry pupil, for a microscope it's the exit pupil. The eye's entry pupil is in the center of the iris and measures from 3mm to 7mm in diameter. A microscope's exit pupil measures from 1.5mm to 3mm and can be easily seen by placing a white piece of paper in the place where a user would normally position their eyes. With the microscope focused on a bright object, you will then see two distinct circles of light above each lens. When using a microscope, the eye's entry pupil and the microscope's exit pupils need to match up almost exactly or at least be close, to produce the cleanest and clearest image of the object.



2mm light diameter from a conventional microscope

Precise alignment

Reaching optimum viewing using a traditional stereo microscope takes a lot of maneuvering; an operator's entire body needs to properly adjust to align the exit pupils. From top to bottom—eyes, head, neck, back, shoulders, arms, seat, legs and feet must all be properly positioned and then—stay there.

Why? It all comes back to the exit pupils. Because the margin for properly aligning exit pupils is so small, staying in a fixed position is essential to maintaining the best possible view of the object.

How do these constraints affect operator performance and productivity?

1. Head movement - to keep exit pupils aligned, operators must severely limit any head movements, otherwise, the exit pupils become misaligned and the image is obstructed.
2. Body positioning - operators must maintain an unnatural, fixed body position to keep their eyes in position with the eyepieces. Holding a position for lengthy periods of time causes body fatigue and can cause long-term neck and back problems, and more.



3. Eye distance - eyes must stay very close to the eyepieces to keep objects in view, i.e., eye relief. Keeping the eyes in a rigid position for long periods can cause eye fatigue and headaches.
4. Corrective lenses - traditional microscope eyepieces are not optimal for operators who wear corrective lens or safety goggles. This results in even less user freedom and greater operator fatigue. Also, employers may need to accommodate them by adding sometimes costly adapters and extensions
5. Eye adjustments - each time an operator loses focus or takes their eyes away from the eyepieces, the eyes must adjust. Repetitive iris expansion, contraction and refocus causes eye strain and fatigue.
6. Eye disease - because operators must stay close to the eyepieces, their eyelashes may come in direct contact with the eyepieces. Cross contamination of eye infections can occur if the microscope is used by multiple operators.
7. Age - as the eyes age, the eye's ability to adjust diminishes, further compromising the exit pupil margins and decreasing the chances for proper exit pupil alignment.
8. Hand to eye coordination - with traditional microscopes, hand to eye coordination is sometimes difficult because the short distance between the eye and the eyepiece limits peripheral vision.

Ergonomics - pain, performance and productivity

Ergonomics - the study of the connection between operators and their environment, particularly the equipment they use.

When operators are uncomfortable, production and quality suffer, costing you money. Years of hard data confirms that traditional microscope usage causes many health-related operator issues and injuries due to poor ergonomics.



Studies show -

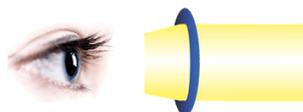
- 94% of microscope users reported visual problems or a combination of eye discomfort including headache and dry eye. Many subjects complained of eye fatigue during microscope use.¹
- 85% of microscope users have experienced pain and discomfort related to microscope use.²
- Around 78% of microscope operators have suffered from neck strains. Slight inclines of the head, such as looking into eyepieces (30 degrees from vertical), can produce significant muscle contractions, fatigue and pain.³
- Around 62% of microscope operators declared suffering from musculoskeletal problems. Common locations were neck and back. Other problem areas included shoulders, wrists and hands.¹
- Around 55% of microscope users have experienced frequent headaches.²

If operators use microscope best practices, training and education, including taking short breaks and getting up from work every 30-60 minutes, operator injuries can be reduced, however, so is the time spent working.

Vision Engineering enters the picture with an expanded view

What if the exit pupil diameter could be expanded? How many of these ergonomic-related issues would vanish?

One company, Vision Engineering, has done just that by replacing the traditional microscope eyepieces with innovative, ergonomically-designed eyepiece-less technology that improves microscope optics and operator comfort.



35mm exit pupil from a Vision Engineering eyepiece-less microscope

How? Eyepieces are replaced by a window through which the exit pupil is projected with an exit pupil diameter up to 35mm, depending on whether the microscope is the Mantis (inspection and rework), Lynx EVO (inspection and rework) or Swift PRO (inspection and measuring) model.

The revolutionary innovation vanquishes a multitude of problems. Operators experience far less fatigue and strain making them more efficient, accurate and productive. The eyepiece-less technology allows them to -



- Enjoy greater freedom of head movement
- Hold a natural and comfortable body position
- Remove the need to precisely align their eyes
- Move their bodies without losing the image
- Manipulate objects without losing focus
- Improve hand to eye coordination
- Gain enhanced depth perception
- Reduce eye strain
- Comfortably wear prescription eyeglasses and goggles
- Avoid eye infections through cross contamination

Like to see Vision Engineering's eyepiece-less microscopes in-person or hear more about how they can save you time and money? Please contact us.

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About Vision Engineering

Vision Engineering is a world leader in manufacturing eyepiece-less **stereo and digital microscopes** and **non-contact measurement systems**. With offices across North America, Europe, and Asia and over 120 stock holding distributors around the world, access to our patented stereo microscopes, optical measuring systems and our expanding range of inspection products has never been easier.

¹Garima Jain and Pushparaja Shetty Occupational concerns associated with regular use of microscope: International Journal of Occupational Medicine and Environmental Health 2014;27(4):591-598

²Thompson SK, Mason E, Duker S. Ergonomics and cytotechnologists: reported musculoskeletal discomfort. Diagn Cytopathol. 2003;29:364-367.

³Fritzsche et al.; licensee BioMed Central Ltd. 2012