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Microscope Components Explained

Compound Microscopes essentially consist of both structural and optical components. Here are some of the basic components that every microscopist should know and understand. Some of the essential microscope parts and their functions are explained below.

Microscope Viewing Head

This is the structure which fits on top of the microscope frame and houses the eyepieces. Three types of viewing heads are available: **Monocular, Binocular and Trinocular.**

Binocular is recommended for comfort and ease of use, and trinocular is useful for photography and video add-ons. The angle of the eyepiece positioning is important and ideally 30 degrees is the most popular and comfortable viewing position. There are two basic viewing head designs, the Jentsch head and the Siedentopf head which vary allowing for adjustment of interpupillary distance. In the Jentsch design, the eyepieces are adjusted by sliding them horizontally apart. Refocusing is then required after each adjustment. The Siedentopf design allows the two eyepieces to be adjusted just like a pair of binoculars therefore avoiding the need to refocus.

Binocular Head - Siedentopf

Trinocular Head - Siedentopf

Binocular Head - Jentsch

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Microscope Eyepieces

The eyepieces are used to magnify the image received from the objective. Each eyepiece is a separate component of the viewing head and can be supplied separately. However, care should be taken if replacing them, ensuring the bottom diameter fits correctly. Most eyepieces are supplied as Wide Field (WF) with a field of view or diameter of 18mm and a magnification of 10X.
It is vital that eyepieces are kept clean and are not removed from the head unnecessarily or taken apart. Should any dirt or dust get inside the eyepieces, it is more than likely they will have to be replaced.

Eyepieces and Diopter

Microscope Diopter

This is a simple turning device which is either attached to the outside of an eyepiece tube of a binocular head, or to the eyepiece itself. When the diopter is turned, it raises or lowers the eyepiece in order to adjust the focus for each eye. This improves the magnification and also the clarity.

Microscope Nosepiece

The nosepiece normally holds 4 or 5 objectives which can be changed during use by simply turning until the next objective clicks into place. The nosepiece is angled so that the objectives either face towards the operator, making the lenses easier to clean, or away from the operator, making changing slides and objectives more accessible . Finally, objectives should be positioned in the nosepiece next to one another and in order of their magnification for example, 4X, 10X, 40X, 100X.

Microscope Objectives

Nosepiece/Objectives

Objectives are responsible for the initial magnification of the specimen image and contain two or more lenses. The number of lenses depends on performance quality.

There are basically two types of objective quality: Achromat and PLAN.

* Objectives are corrected for field curvature and also colour aberration. It is the degree of the flatness of field which is the difference between an Achromat and PLAN objective lens.

Achromat objectives: Produce good quality images however, the perimeter is slightly blurred with 65% of the image in flat focus.

PLAN objectives: The curvature of the lens has been corrected and this results in a much sharper, clearer and in-focus image which is more suitable for photographic work. As a result there can be significant cost difference between the two types of objectives. Most microscopes are supplied with 4 colour coded objectives: 4X (red), 10X (yellow), 40X (blue), 100X (white). The total magnification can be calculated by multiplying the objective magnification by that of the eyepieces. The maximum magnification that can be achieved with the ordinary light microscope is approximately 1000X.

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Parcentred and Parfocal

All objectives should be *parcentred* and *parfocal* . *Parcentred* means that the central point of the image does not alter after the objectives have been changed. *Parfocal* ensures that the image will stay in focus either completely or partially even after any of the objectives have been swapped.

Ideally, the 40X and 100X objectives would have a spring-loaded nosepiece, avoiding damage to their bottom lens or the slide. The 100X objective is normally used with immersion oil however, 60X objectives can be so good nowadays it is possible to use a 60X without immersion oil for higher magnification purposes. All objectives are designed to be used with coverslips on the sample slide. By using coverslips the 40X and 100X objectives are in '*selected image resolution* ' which notably improves the quality. Most objectives will have '0.17' inscribed on them, this refers to the average thickness of a standard coverslip (0.17mm). There will always be some variations in the thickness of coverslips, however, this is the industry standard for most applications.

Mechanical Stage

This is an essential feature of any diagnostic microscope especially for high magnification work. This device incorporates a slide holder which can be moved smoothly left and right (X axis) and back and forth (Y axis) whilst the operator looks down the microscope. Modern mechanical stages consist of two layers and low positioned X-Y coaxial controls which enable greater comfort and ease of use for the operator. In addition, graduated location markings on both the X and Y axis enable the user to record the coordinates of interesting objects on the slide for future reference and photomicrography.

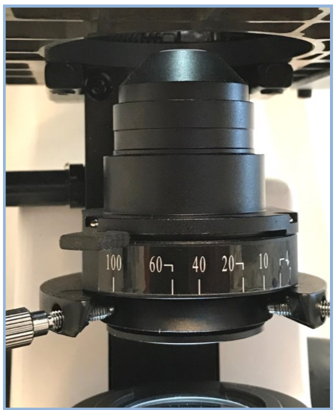
Mechanical Stage

Focus Controls

Most microscopes have coaxial coarse and fine focus controls on either side of the main frame. Their function is to move the stage up and down in order to bring the specimen into focus. It is important that the mechanism is engineered to a high standard because the focus controls will get the most wear. Their ergonomic design and the presence of a tension adjustment control to adjust movement definition can all help to improve their ease of use.

Condenser

The condenser is essential for collecting and directing light from the light source onto the specimen and through the objective and also for helping to adjust contrast of the final image. The Abbe condenser is the most common type in use, containing two lenses, an adjustable iris diaphragm and a filter holder. It is usually held underneath the stage in a cradle which should be adjustable in height and have three screws, two of which are used for centring the condenser. The iris diaphragm can be opened and closed by moving a lever which controls the diameter of the beam of light reaching the specimen and objective. This feature together with the ability to adjust the height of the condenser, helps to adjust and improve the contrast and resolution of the Image, particularly when using the 40X and higher power objectives. The iris diaphragm when fully closed, is useful for centring of the beam of light, by using the two cradle screws which move the condenser from side to side.



Condenser

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Light Source

There are two types of light source for microscopes:

Halogen and LED. Both types are suitable as long as the light source is powerful enough. Halogen bulbs should be at least 20W and LED at least 3W. Halogen type bulbs produce a mixture of light wave lengths whereas LED produces light more at the blue end of the spectrum and is often described as 'white 'light or more like daylight. However, the light from halogen type bulbs can be modified by using a blue filter to become whiter.

Light Source

LED lights can last for up to 50,000 hours whereas halogen bulbs may last only a few hundred hours. However, bulbs are easily replaceable but LED light sources, at present, have to be soldered in place by a qualified electrical engineer. Notably, LED does not generate heat whereas halogen type bulbs can make the base quite hot after a while. In addition, some LED microscopes have been designed to be used both from the mains power and batteries allowing them to have the flexibility to be used in 'the field', or in situations where mains power is unavailable.

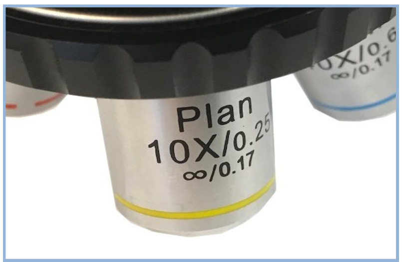
OPTICAL SYSTEMS

Finite Optical System

The vast majority of microscopes use this system, particularly those at the less expensive end of the market where there is a fixed distance between objective and eyepieces. This distance is called the 'mechanical tube length' and is standardised at 160mm (DIN standard). It is important that objectives used on these microscopes are designed to work at this distance and have the number '160' inscribed on the outside of their barrel.

Infinity Optical System

Infinity microscopes have tube lengths varying from 160 to 200mm and have an extra 'tube lens' positioned in the body (often in the viewing head). Arguably, Infinity microscopes provide slightly better quality images than Finite microscopes especially when combined with PLAN objectives and used for photomicrography. It is important that these microscopes are fitted with *Infinity Corrected Objectives* which have an *Infinity symbol* inscribed on the barrel along with a matching viewing head with Infinity and tube lens.



Infinity Symbol

Choosing The Right Microscope

Finally, getting the right advice and talking to an expert is essential. Our 'Choosing your Microscope' article is full of hints and tips and great advice ensuring that you pick the right instrument for your requirements. Vetlab Supplies Ltd www.vetlabsupplies.co.uk info@vetlabsupplies.co.uk

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