



Microscope Terminology, Features & Accessories



novatech
INTERNATIONAL

sales@novatech-usa.com

www.novatech-usa.com

Tel: (866) 433-6682

Fax: (866) 433-6684

Tel: (281) 359-8538

Fax: (281) 359-0084



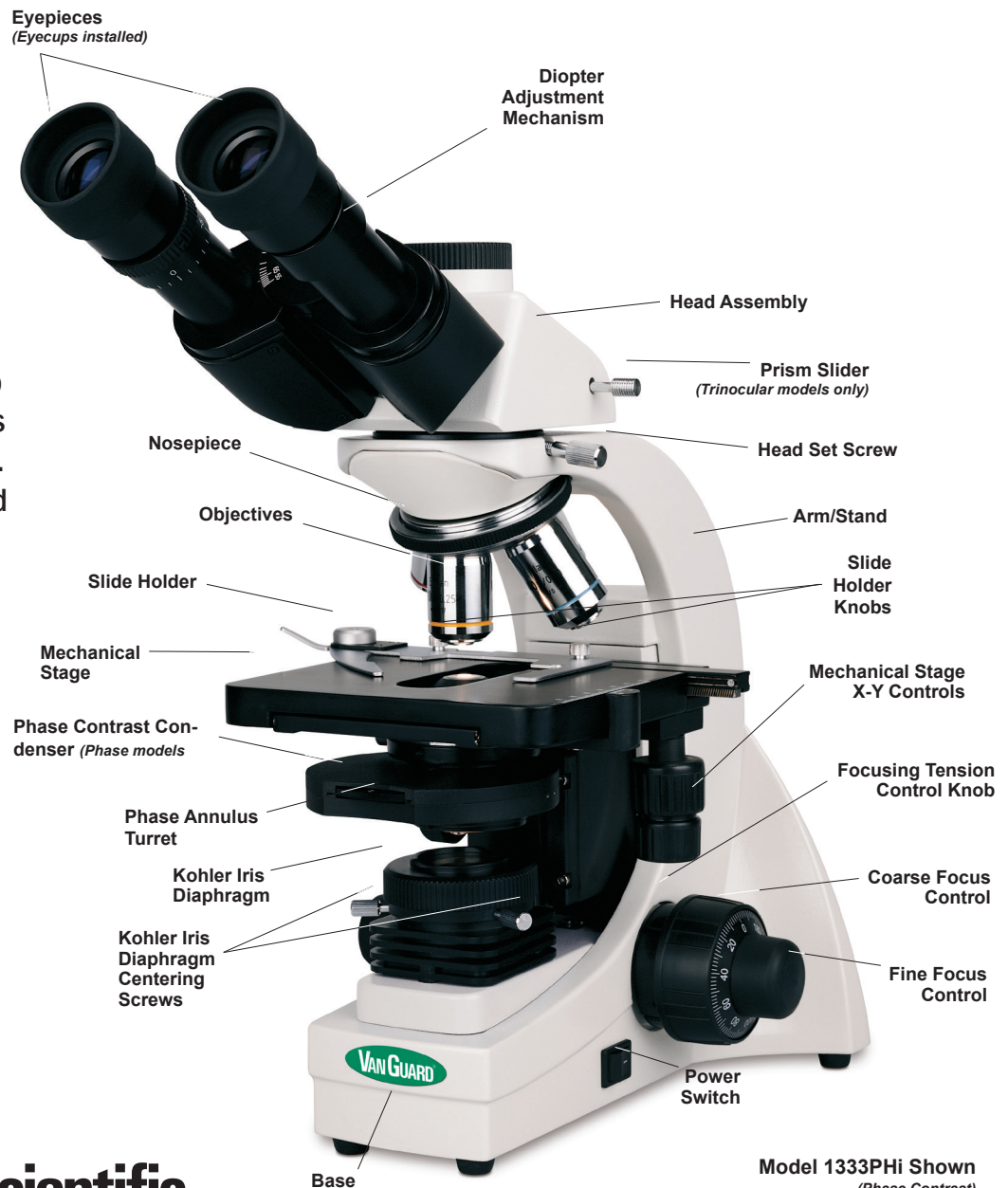
VEE GEE Scientific, Inc.

13600 NE 126th Place, Suite A • Kirkland, WA 98034
(800) 423-8842 • (425) 823-4518 • Fax: (425) 820-9826
www.veege.com • email: sales@veege.com

Introduction

With the invention of the microscope in the early 17th century, it was made possible to view objects which were too small for the human eye to see. As the microscope evolved, the structure of cells, plants, animals, and other materials could be studied in detail allowing greater insight into a world previously unknown. Today, microscopes are used to support a variety of scientific and medical research facilities ranging from the study of plants and animals to bacteria and viruses; they are also widely used in industrial facilities to study metals, fibers, and textiles. Microscopes are both a wonderful and necessary tool for many aspects of modern research. Because of this, choosing the proper microscope for a given application can sometimes be difficult. This instructional brochure is intended to serve as an introduction to the various types of microscopes available through VEE GEE Scientific, Inc. under the VanGuard brand name and to answer some of the most common questions relating to microscopy.

The diagram below displays the principal parts, described on the following pages, of a research-level compound microscope (it will be helpful to refer to this diagram while reading the information).



Model 1333PHi Shown
(Phase Contrast)

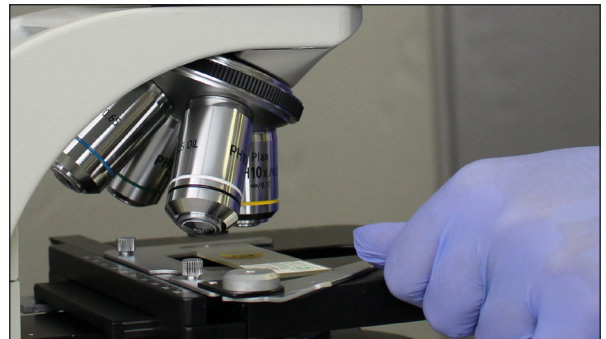
Types of Microscopes

Light Microscopes, sometimes referred to as optical microscopes, use visible light to create magnified images of objects. They are the most common microscope used today and are the type available through VEE GEE Scientific, Inc.

Normally, light rays travel in straight lines; however, if light rays pass through substances such as water or glass, they are bent or refracted. In modern optical microscopes, lenses made of curved glass or special plastics are used to refract light and produce images of objects in which the finest details can be observed. By using lenses of different shapes and varying the number of lenses used in the objectives, the magnification and image of an object is altered.

Light microscopes are divided into two primary styles: simple and compound. Simple microscopes make use of only one lens (i.e. a magnifying glass). Compound microscopes have more than one lens (i.e. objective and eyepiece lenses) and are the style discussed in this brochure.

With compound light microscopes, two lenses (the objective and the eyepiece) are mounted at opposite ends of a closed tube and produce an image which is a number of times larger than the actual image. These two lenses determine how great the object on the microscope stage will be enlarged or magnified. The total magnification of the microscope is determined by multiplying the magnifying power of each of the lenses together.



The object to be studied is placed on the stage and a slide can be held in position with clips. An opening in the center of the stage lets light in from either underneath or above the object. The focusing knobs are turned to bring the object into clear view. The objective lens first magnifies the object on the stage and produces an image. This image is then enlarged again by the eyepiece lens to give the final image which is viewed through the eyepiece. The ability of a microscope to make fine detail visible is its resolution. In light microscopes, the resolution is determined in part by the wavelength of light produced by the lamp. Resolution is also determined by the angle at which the light enters the objective lens; the larger the angle, the better the resolution.

Most light microscopes used for research have a number of refinements to enable detailed study of different objects. Research microscopes are usually equipped with at least three objective lenses with which the magnifying power of the microscope can be varied. Light microscopes can magnify objects up to approximately 1000 times. Although there are several types of light microscopes, they all work in a similar way. For example: binocular microscopes have two eyepieces, field microscopes are light and easily carried outdoors, and stereoscopic microscopes provide a 3D image of an object.

Electron Microscopes differ from light microscopes in that they use electrons rather than light rays to magnify objects. Electrons have a smaller wavelength than visible light and can therefore resolve smaller structures than light rays. They are capable of magnifying objects at 100,000 times or more.

1333PHI
Trinocular Clinical
Microscope w/
Phase Contrast



1253SL Stereo Microscope:
Note: Even though they are technically classified as compound, stereoscopic microscopes are rarely referred to as "compound." In every day use, compound microscopes are usually considered to be any light microscope which is not stereoscopic.



1442MMi:
Industrial
Metallurgical
Microscope



Microscope Terms & Components

Arm. Attached to the base, the arm (also known as the “tube”) acts as a mount for the head. This is where the focusing assembly is situated as well as the upper illumination on a stereo microscope.

Base. The lowermost portion of the microscope, the base acts as the stabilizing support for the entire instrument. Most electrical components are housed inside the base, typically consisting of a printed circuit board, transformer, switches, and bulb socket.

Condenser. Mounted between the illuminator and stage, the main purpose of the condenser is to focus or concentrate the available light onto the specimen. The more light passing through the section, the better the resolution. Resolution determines the amount of detail which can be seen.

Eyepiece. Focuses the light into the eye and magnifies the image along with the objective lenses. The most common magnification level is 10X, with 15X and 20X available for certain VanGuard models. Two adjustments that are made to the eyetubes containing the eyepieces are described below:



Interpupillary Adjustment. Determines the distance between two viewing eyepieces on a binocular or trinocular head. This adjustment needs to be made for each separate user of a microscope as it relates to the user's particular eye spacing and will greatly affect image quality and long duration comfort level. Most VanGuard binocular and trinocular microscopes feature a Seidentopf head (similar to binoculars) where the interpupillary adjustment is made by folding the eyetubes together or apart off of a center hinge point to increase and decrease the eyepiece spacing. Non-Seidentopf heads use a horizontal sliding adjustment.

Dioptric Adjustment. Depending on the microscope, there will be a diopter on either the left or right, or in some cases both eyetubes of a binocular or trinocular head. This focusing adjustment compensates for variations in users eyesight from eye to eye. As with interpupillary adjustment, the diopter needs to be adjusted for each individual user. The proper method for making the adjustment is to place a well defined, prepared slide on the microscope stage and, using the main focusing controls, bring the image into proper focus while viewing through the eyepiece without the diopter only. Then while viewing through the eyepiece with the diopter, focus the image for the other eye this time using the dioptric adjuster.

Focus Controls. The focus controls increase and decrease the distance between the objective and the specimen to bring the image into and out of focus. The most common and desirable systems utilize a rack and pinion gearing system for easy, fluid motion over the complete vertical travel range of the instrument. Compound microscopes typically feature coarse and fine focus controls, often in a coaxial system. Two terms with regard to focusing and objective changing are listed below:

Parcentration. A microscope's ability to ensure that a specimen remains in the center of the field of view when changing objective settings. Often stated in the form of whether or not a microscope is “parcentered.”

Parfocality. The ability for a microscope to keep an image in focus when changing objective settings. Often stated in the form of whether or not a microscope is “parfocal.” Even with parfocal microscopes it may be necessary to make slight adjustments to the fine focus controls when switching objectives.

Head. On a compound microscope, the head houses the eyepieces and diverts the image to various eyetubes. The head on a stereo microscope is much more complex, as it contains all of the optical components. The head is mounted on top of the microscope arm.

When stated, the head of a microscope will usually be preceded with one of the following terms: monocular, binocular, or trinocular; which indicates one, two, or three oculars (eyetubes), respectively. Monocular models have only one eyepiece, binoculars have two, while trinoculars have two eyepieces with the addition of an upright ocular to attach photo or video equipment.

Infinity Correction. Many of the compound type VanGuard microscope models feature infinity correction. This refers to a lens system that produces parallel light beams which converge into a focused image only after passing through a final tube lens. This is unlike the finite focal length systems (160mm for VanGuard non-infinity microscope models) that produce a focused image by the objective lens itself. The advantage to the infinity system is that it's possible to increase or decrease the tube length, typically through the addition or removal of auxiliary lens units, without affecting the image quality negatively.

Iris Diaphragm. An aperture, attached to the bottom of the condenser, used to induce contrast into a sample by controlling the diameter of the light beam. If the diaphragm is closed too far, the image becomes too dark. Inversely, if left wide open the image will be washed out and without sufficient contrast. The iris diaphragm should not be used to control light intensity.

Magnification, Overall. The overall (or working) magnification of a microscope is the combined magnification of all lenses currently in the focal path. For instance, a stereo zoom microscope using 10X eyepieces, a 1.5X supplementary lens, and a 2X objective setting would result in an overall magnification level of 30 ($10 \times 1.5 \times 2 = 30$).

Nosepiece. Also referred to as the objective turret -- the part on a compound microscope which holds the objectives. The nosepiece is completely rota-table with setting detents for quick and easy magnification changes.

Objective. The lens system which is closest to the specimen and is responsible for the initial magnification. It's essentially the information gathering lens of the complete optical system. Most compound microscopes are equipped to hold either 4 or 5 objectives which are housed in a revolving nosepiece or turret. The objectives in a stereoscopic microscope are arranged in pairs (one objective for each eye) to create a three-dimensional effect and are either at fixed magnification levels or are variable between two set limits (zoom). The objectives available for VanGuard models are achromatic, plan-achromatic or plan fluorite and are described next:

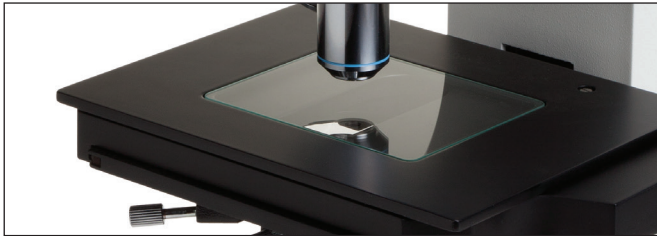


Microscope Terms & Components (continued)

Achromatic. The term “achromat” indicates that the lens system has been optically corrected for chromatic aberrations in the red and blue wavelengths and spherical aberrations in the green wavelength. Achromatic lenses tend to produce a small amount of curvature at the perimeter of the field so that when the majority of the field is brought into focus, a small ring just at the perimeter of the field will be out of focus. For many users, this is barely noticeable and totally acceptable.

Plan Achromatic. Spherical aberration, in addition to chromatic aberration correction plan objectives utilize a series of lenses to eliminate the natural curvature at the perimeter of a standard objective field. Plan objectives produce an image in which nearly 100% of the field is in focus simultaneously. A very important feature for applications requiring the use of the entire field of view (cell counting, etc).

Plan Fluorite. The highest level of correction available for a VanGuard objective is plan fluorite which, in addition to the spherical and chromatic corrections listed above, is manufactured from advanced glass formulations allowing for additional spherical corrections beyond what is possible with an achromatic lens. This produces a lens system with a brighter image, better resolving power and higher contrast.



Stage. The stage lies above the base and is a rigid, flat platform. Usually, it features an opening (aperture) through which light can pass through the specimen. The stage's purpose is to hold the specimen in place. A mechanical stage features coaxial controls used to move the slide in two directions to allow easy viewing of the whole specimen.

Substage. The area located below the stage. On upright microscopes, the substage assembly contains the condenser / iris and is mounted in a movable rack and pinion mount. The nosepiece and objectives are located in the substage area of an inverted microscope.

Illumination Techniques / Contrast Methods

Brightfield. Traditional transmitted light microscopy where light is directed through the sample and then to the user's eye. Contrast in the sample is obtained by using a number of different techniques including sample staining and light intensity adjustment. The sample is seen as a darkened or colored structure against a white (bright) background or field.

Phase Contrast. Lighting configuration which is designed to induce contrast into the sample without staining. Phase contrast uses a series of “light baffles” to take advantage of refractive differences in the sample structures. The system uses an annuli mounted in the objective itself. Phase contrast objectives are distinguished separately from other objectives with markings on the outer casing, typically with a “PH” notation. It is important to note that phase contrast objectives can be used for brightfield work. The phase condenser turret has a setting which does not contain an annuli (the “0” setting). When the turret is placed in this setting the light will transmit throughout the stage normally for brightfield work. However, the objective-mounted annuli will interfere slightly, so brightfield objectives are recommended for extensive brightfield work.

Darkfield. Capitalizes on oblique illumination to enhance contrast in specimens that are not imaged well under normal brightfield conditions. Darkfield illumination requires blocking out the central light which ordinarily passes through and around (surrounding) the specimen, allowing only oblique rays to “strike” the specimen. This is achieved using a special darkfield condenser. Many VanGuard phase contrast microscopes also feature a darkfield stop.

Fluorescence. An excellent method of studying material which can be made to fluoresce with a UV light source, either in its natural form or when treated with chemicals capable of fluorescing. Fluorescent molecules absorb light at one wavelength (excitation) and emit light at another, longer wavelength (emission). Only the emission light reaches the eye and is visible against a black background.

Transmitted vs. Reflected Light

Transmitted. The light passes, or transmits, through the specimen. The most common light source found on compound microscopes. Used on stereo microscopes when analyzing translucent objects.

Reflected. The light reflects off of the specimen, also referred to as “incident”. A must for analyzing opaque samples. Some compound microscopes make use of an “episcopic illuminator” which directs the light path down through the objective, the light reflects off of the sample, then proceeds back up through the objective to the eyepiece.

This type of light source is found on both fluorescence and metallurgical microscopes. Stereo microscopes simply have an upper illuminator which shines down from above and reflects light off of the sample. Used primarily for gems, coins, electronic parts, etc.

Compound vs. Stereoscopic

Compound. The eyepiece system may be monocular, binocular, or trinocular. Monocular observation uses one eyepiece, binocular observation uses two. Binocular observation is more comfortable, less fatiguing, and if the microscopist uses both eyes they are less strained than one eye with monocular observation. Trinocular microscopes contain an additional upright ocular which is utilized when the microscope is used with a photo or video system.

Compound microscopes use only one objective at a time, although different ones are available on the objective turret.

To observe small animals in water, sections of plant parts, and/or animal and plant cells, a microscope with an overall magnification range from 25X to 400X is required. To examine bacteria, blood counts, chromosomes, etc. -- the microscope's total magnification should reach 1000X.

The two principal compound stand configurations are listed below:

Upright. (Shown Left), The most traditional and common stand available. The light source is located under the stage and the light is transmitted up through the specimen, through the objectives, and to the eyepieces.



Inverted. (Shown Right), Literally uses an “inverted” optical light path. The light source is located at the top of the microscope and the objectives are mounted upside-down under the stage. This allows the viewing of specimens in large containers (i.e. petri dishes, vials) requiring much greater working distance than is available on an upright stand.

Stereoscopic. Also referred to as stereo, stereo zoom, or dissecting microscopes. Stereoscopic (3D) vision is possible by the combined action of two eyes. This requires an independent optical system for each eye (similar to how binoculars work). A stereo microscope features two tubes with independent optical systems with two eyepieces and two objectives. Which means that a stereo microscope is, in fact, a combination of two compound monocular microscopes whose optical axes are at a right angle to each other and directed to the same specimen area.

Stereo microscopes are used for viewing natural specimens such as minerals, insects, plant parts; they are also used for technical applications such as illuminating coins, textiles, and electronic components. Because of its long working distance, dissection and precision assembly are possible under the stereo microscope.

The magnification levels on a stereo microscope can be either at fixed levels (i.e. 2X & 4X), or they can be in a gradient range between two limits, as with the stereo zoom microscope (i.e. 0.7X to 4.5X).

Microscope Accessories



VanGuard 1400-MCL microscope cases provide superior protection for nearly all clinical and industrial microscopes when used for transport in the field.



- Hard-Shell Protection
- Nylon Exterior w/ Padded Interior
- Accessory Pockets and Velcro Straps
- Interior Dimensions: 12 x 9.5 x 18"



There are various stands available for stereo / stereo zoom microscopes. The most common utilizing both an upper (incident or reflected) and a lower (transmitted) light source. There are also pole stands -- without any illumination for applications where an external light source is being used, and boom stands -- also without illumination, where greater maneuverability of the microscope is required.

The IS-Series digital cameras from VanGuard produce high definition live images and video for the documentation and archival of clinical, life science, and material science laboratory imaging analysis.

The full-featured ISCapture imaging software allows the user to easily control all of the camera's advanced settings and has a simple but powerful graphic interface. Full capture solutions are included to provide the user with the ultimate in live image analysis and archival.



The 1200-LED1 system utilizes two fully discrete LED's mounted on posable goose-neck guides with independently adjustable intensity controls. For ultimate versatility the light guides are removable and interchangeable with other optional LED1 Series guides. The system comes standard with two single, 6500k light guides as a complete package.

- Long Life LED Illumination
- 150 kLux Output (at 2")
- Two 24" Light Guides Included
- Posable Goose-neck Guides
- Discrete Intensity Controls
- Master Power Switch
- Optional Ring Light Attachment

