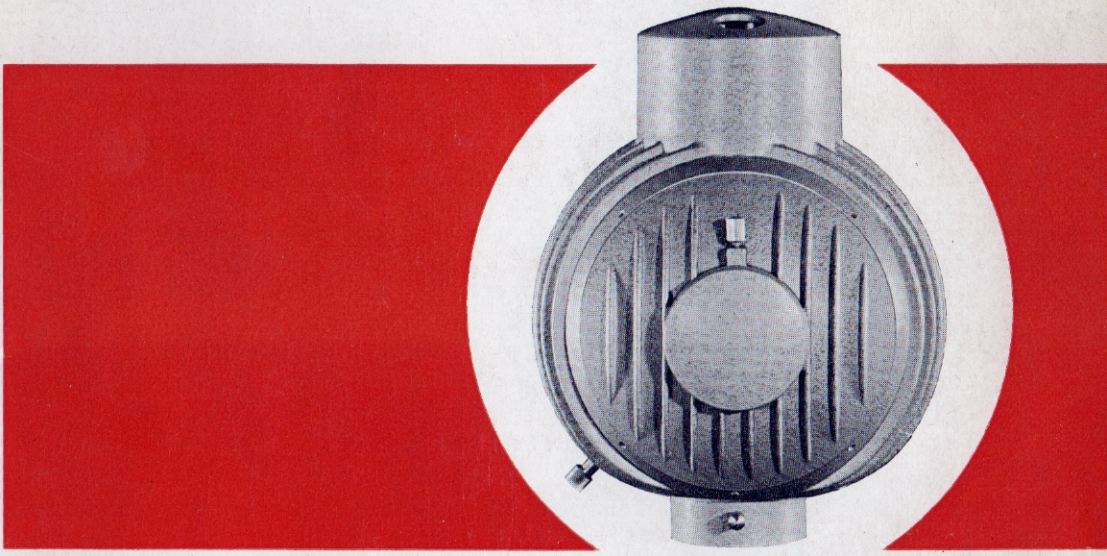
CARL ZEISS

Multi-Purpose Microscope Illuminator

Operating Instructions



BEFORE switching illuminator on, check whether the correct power supply unit (transformer, choke, rheostat) is being used. See table on page 21.

BEFORE inserting lamp socket into the housing, wipe off fingerprints or other marks with distilled water or alcohol so they will not burn in.

BEFORE switching on the current, insert the lamp socket into the lamp housing which shields against contact and radiation.

BEFORE removing lamp socket from lamp housing, disconnect plug from wall socket!

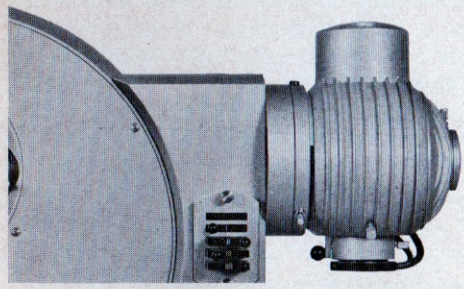
High-pressure Mercury Lamps

BEFORE connecting to AC current, set the power supply unit, when using a mercury lamp HBO 200, to either L 1 or L 2 as indicated on the lamp. If halide-metal CSI lamps are used, always set the unit to L 2.

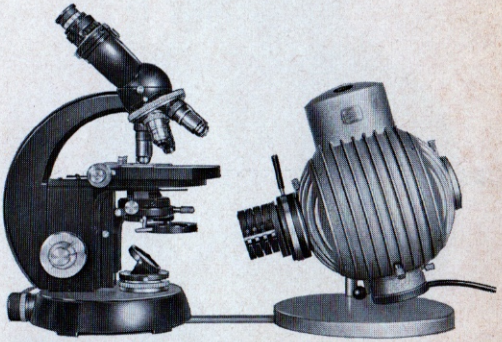
Check whether the correct line frequency (50 or 60 cps) is set on the power supply unit.

Multi-purpose Microscope Illuminator

The lamp housing is designed to accommodate most of the light sources commonly used in microscopy and photomicrography.
Depending on the microscope stand either of the following two models can be used:



1 Rigidly mounted (page 4)



2 Adjustable, on table stand (page 5)

The following applies to both lamp housings:

The socket is introduced from below along a guiding groove for correct orientation (insertion of lamp on page 16).

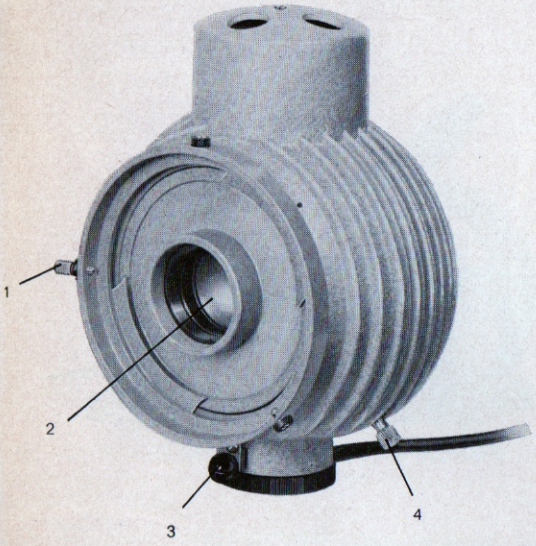
By turning the adjusting screw (Fig. 22), the socket can be tilted to center the light source.

A diffusing screen is swung into the light path with the black knob (3 in Fig. 3). The screen should always be used in connection with a filament bulb, but never with gas discharge lamps. The rear cover of the lamp housing is removable.

If the lamp housing is supplied with a xenon lamp, the cover is provided with a concave mirror; for all other light sources the mirror would act as a disadvantage and is therefore omitted. The cover should be tightly secured when the illuminator is in operation.

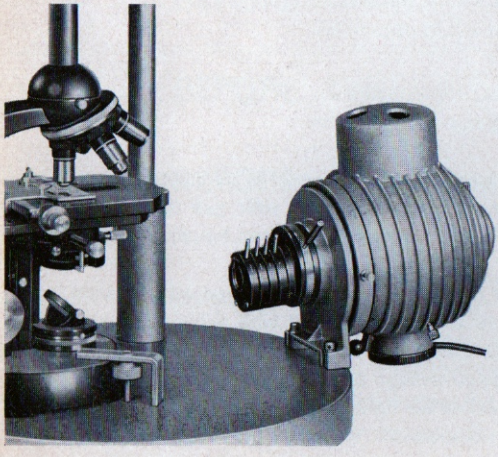
Rigidly mounted illuminator

The lamp housing (47 25 10) is rigidly attachable to a dovetail ring. This applies to the lamp holder on the heavy base plate (attachment camera), the special-purpose illuminator (PHOTOMICROSCOPE, UNIVERSAL), the ULTRAPHOT II, the MICRO CINE CAMERA and the microprojection base. The collector is permanently adjusted and forms an image of the light source at infinity. The lamp housing is not equipped with an iris diaphragm. The diaphragm of the lamp holder for the base plate, or the field diaphragm of the microscope, act as a field diaphragm (PHOTOMICROSCOPE, ULTRAPHOT II).



3

1 = Clamping screw for lamp housing
2 = Permanently adjusted collector imaging the light source at infinity
3 = Knob for movement of the diffusion disc
4 = Centering screw for light source



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Lamp housing attached to lamp holder on the heavy base plate for the microscope. The holder has a lens for imaging the source in the correct plane as well as an iris diaphragm (field diaphragm). The filter holder is the same as the one described on page 5.

Illuminator on stand

The lamp housing can be tilted, swung partially around and adjusted vertically on the column.

To firmly connect the illuminator on stand with our STANDARD Microscopes, place both on **connecting bar II.** The two studs on the cross bar engage in the holes in the microscope base. The single stud on the long bar fits into the last hole on the underside of the illuminator stand (in the case of the fluorescent illuminator, into the central hole).

Insert the **collector** with iris diaphragm into the lamp housing. Clamp it by means of the clamping screw so that the lever of the diaphragm is in a convenient position for operation. If the filter holder is removed from the collector, the diaphragm should be fully opened to protect the blades from damage. For fluorescent illumination, a light-protection tube should be inserted between collector and filter holder.

The quadruple filter holder is attached to the collector by its bayonet-type thread mount (red dot opposite red dot). Filters of 32 mm diameter are held by spring clips in the four swing-out holders. They can easily be exchanged by pushing them forward out of the holders. It is advisable to use a cloth for this purpose to avoid fingerprints.

If certain filters such as **heat-absorbing filters** are to remain in permanently, they can be inserted from the lamp side into the carrier of the filter holder before the latter is mounted.

Heat-absorbing filters are required for use in conjunction with the gradation filter monochromator, polarizing filters and filters for fluorescence microscopy. Only KG-1 heat-absorbing filter (46 78 30) should be used with the latter, but in all other cases the Calflex (reflection-type) filter (46 78 32) is employed. With this filter, the more strongly reflecting side, marked L, must face the light source.



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Data of light sources

Light source	Luminance (stilb)* approx.	Luminous flux (lumen) approx.	Luminous intensity (candela) approx.	Color temperature (° Kelvin)	Radiant area (mm)
Projection bulb 220 V, 100 W (38 08 13)	250	1700	150	2900**	7×6.5
110 V, 100 W (38 04 14)	600	1950	175	3000**	6×5
Low-voltage bulb 12 V, 100 W (38 02 15)	1600	2300	180	3150**	4×3.7
Sodium spectral bulb (38 11 03)	12		30	discontinous spectra: indication of color temperature pointless	10×5
High-pressure mercury lamp HBO 75 W (38 16 02)	4400	2500	275		3×1.5
High-pressure mercury lamp HBO 200 W (39 16 03)	25000	9500	1100		2.5×1.3
High-pressure mercury lamp HBO 200 W/4 (38 16 15)	33000	9500	1000		2.5×1.3
Halide-metal lamp CSI 250 W (38 16 22)	15000	16000	1600	3800	5×2.5
Xenon lamp XBO 150 W/1 (38 16 17)	15000	3000		6050	2.2×1.1
Other microscope illuminators for comparison					
Low-voltage bulb 6 V, 2.5 A (15 W) (38 01 77)	850	220	25	2850**	1.6×1.8
Low-voltage bulb 12 V, 5 A (60 W) (38 02 16)	1250	1000	130	3050**	3.2×3.2
Microflash unit (48 70 12)	Energy 30 or 60 watts, flash duration 1/3000 or 1/2000 sec			5500	

* Theoretically, the brightness of the microscopic image has a fixed relationship to luminance, but in practice it is strongly affected by the optics of the microscope.

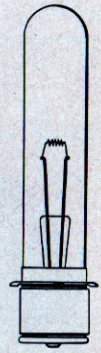
** This data refers to rated voltage. For voltage deviations see diagram, Fig. 9.

Light sources

The light sources vary considerably in voltage needed, and specific power supply units are therefore available for each one. To ensure proper connection, the cable of each lamp socket has a different type of plug.

Color photomicrography:
Under certain conditions, the color temperature within the microscope may vary slightly, e. g. a chromium mirror will provide a "warmer" light than an aluminium mirror. For critical work it is recommended to make test exposures.

The low-voltage bulb 12 V, 100 W (Fig. 6) is particularly suitable for photomicrography. The color temperature of approx. 3.200° Kelvin required for artificial-light color film is already available at the lamp's normal operating voltage of 12 V.



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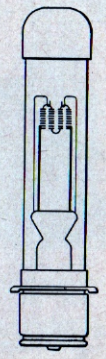
For connecting the lamp to AC, a transformer is available with taps for 10, 12 or 15 V. The bulb can also be operated, however, with a regulating transformer equipped with voltmeter or ammeter. If more light is needed, the bulb should not be overloaded for long periods of time because this will shorten the life of the bulb. (See Fig. 8)

Projection bulb 100 W (Fig. 7) is connected without a transformer directly to the line voltage.



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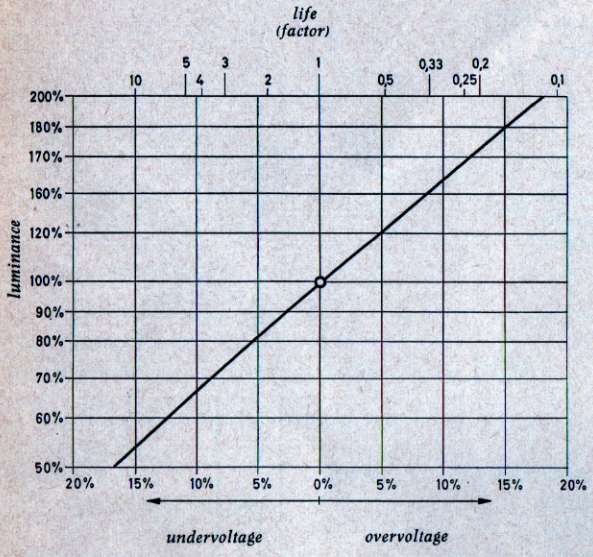
Due to the high operating voltage, the filament must be relatively long. In order to obtain sufficiently uniform illumination in spite of this, a diffusion disc must be placed in the lamp housing.

The curves below represent mean values and are not meant to apply to a particular bulb.



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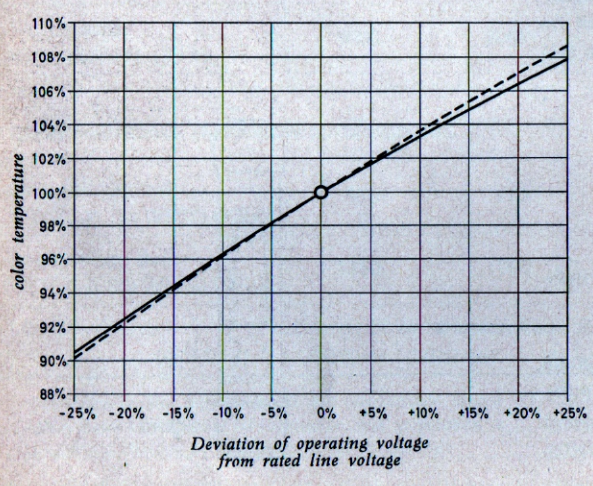
Relationship between voltage, luminance and life of low-voltage bulb.



——— vacuum lamps
- - - - - gas-filled lamps, all types described here

9

Color temperature as a function of the operating voltage of filament bulbs.

2487.
Dr. Wynn.

High-pressure Mercury Lamps HBO 200 W

The energy distribution of high-pressure mercury lamps HBO 200 corresponds more or less to that of the mercury vapor spectrum. However, a weak continuum, which is due to the glowing electrodes, is superimposed on the spectral lines.

As the light of this lamp is very rich in ultraviolet and blue, it is especially suitable for fluorescence microscopy. Its extraordinarily high luminance is very advantageous for fluorescence photomicrography.

Owing to the unavoidable manufacturing tolerance of the internal resistance of the lamp, we distinguish between lamps of type L 1 und L 2. The choke has two different amperages and must be set for the type of lamp used (see pages 10 and 11, respectively).

During observation, no harmful ultraviolet light can enter the eyes of the operator, because short-wave radiation is absorbed by the optical system of the microscope. If ozone develops, a window should be opened.

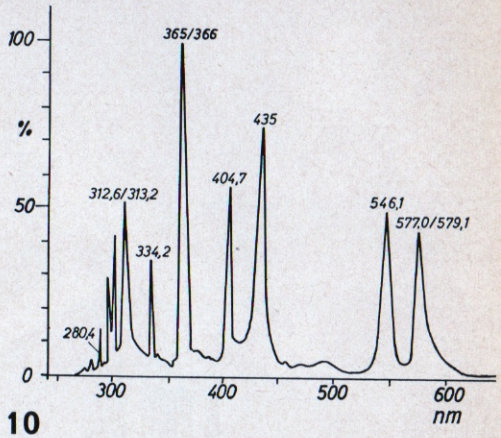
The star-shaped cooling attachment, which is screwed to the upper electrode, dissipates the heat.

If the upper electrode should oxidize in the course of time, the contact should be cleaned with fine emery paper.

After switching on, high-pressure mercury lamps require a certain "warming up period", because the required operating pressure is built up by evaporation of the mercury.

Due to their high operating pressure of 35—70 kg/cm² (1 kg/cm² = 14.69 psi), these gas discharge lamps must be operated exclusively in closed lamp housings.

To start the lamp, press the starting key immediately after switching on. A cold lamp usually starts without delay, while a hot one requires a short cooling-off period.



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Spectral emission of high-pressure mercury lamps HBO 200 and HBO 75 W



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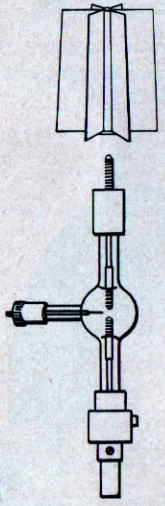
Screwing the cooling attachment onto HBO 200 and XBO 150 lamps (hold electrode firmly!)

HBO 200 W Lamp

This lamp with its laterally arranged ignition electrode can be operated on both AC and DC.

The choke (39 26 22) is used for connection to 220 V AC. The frequency selector for 50 or 60 cps is on the underside of the instrument. Before use, the red screw in the bottom plate should be set to I (3.6 A) for L 1 lamps and at II (4.2 A) for L 2 lamps.

For connection to other AC voltages, a 1000 VA step-up transformer (39 25 28) must be used.



12

Connection to 220 V DC via the ignition unit (39 26 36) and the rheostat (39 19 71) 78 Ohm, 5 A. After a warming-up period of about 5 minutes, the rheostat should be adjusted so that 3.3 A are indicated with L 1 lamps and about 3.8 A with L 2 lamps. Correct polarity of the power plug is extremely important, as otherwise the lamp will burn out.

The red plug (ignition cable) must never be pulled out during operation of the lamp; grounding would immediately blow out the lamp.

Inserting the bulb into the socket

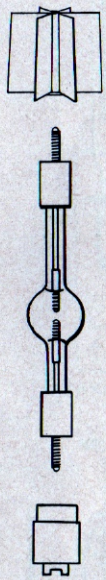
Push the bulb down into the socket under light pressure and lock it by turning it clockwise. The pin in the socket will engage in the groove. Then attach the shorter cable to the lateral ignition electrode by means of a screw and screw the cooling attachment with the longer cable to the upper electrode. Hold the electrode firmly (Fig. 11) to prevent stress on the quartz bulb.

Introduce the socket with the bulb into the lamp housing with the utmost care.

HBO 200 W/4 Lamp

This lamp has no ignition electrode and can be operated only on AC. The light flickers in rhythm with the double line frequency and is therefore not suitable for cinematography (see XBO 150 W/1 lamp).

The lamp is connected to 220 V via the choke (39 26 27; VHW 200 f — 2 b). After taking off the side of the housing, 50 or 60 cps can be selected. At the same time, a black indicator dial should be set from the inside to show the correct frequency on the outside. At the rear is a round slip-on current selector with indicator window. This selector should be set to L 1 or L 2 according to which lamp is used.



13

Inserting the bulb into the socket

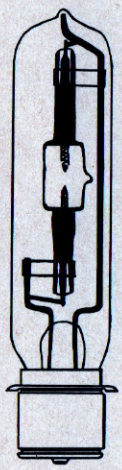
Screw the base (lower part in Fig. 13) to the electrode which bears an identification mark on its shorter end, and tighten the lock screw at the bottom of the base with a coin. Then insert the bulb vertically from above into the socket and tighten the lateral set screw in the socket with a screwdriver. The lamp is then firmly mounted. Screw the cooling attachment (35 mm high) with cable to the upper electrode. Hold the electrode firmly (Fig. 11) to prevent stress on the quartz bulb.

The cooling attachment is only 35 mm high, while in the case of the shorter HBO 200 W lamp it is 50 mm. Be sure not to screw the longer attachment to the HBO 200 W/4 lamp, since it would touch the housing.

Introduce the socket with the bulb into the housing with the utmost care.

Halide-metal CSI 250 W Lamp

This mercury lamp with additions of metal iodide has high efficiency in the longer wavelength region and an attenuating effect in the blue range (energy distribution, Fig. 15). This lamp radiates white light which is appropriate for color photomicrography and polarized-light microscopy. Due to its large, homogeneous radiant area and its high luminance, this source is particularly well suited for all types of microscopic work requiring intense light. It is used for photomicrography, for projecting microscopic specimens, for work with heavily stained specimens and illumination methods in which a large portion of the available light is absorbed.

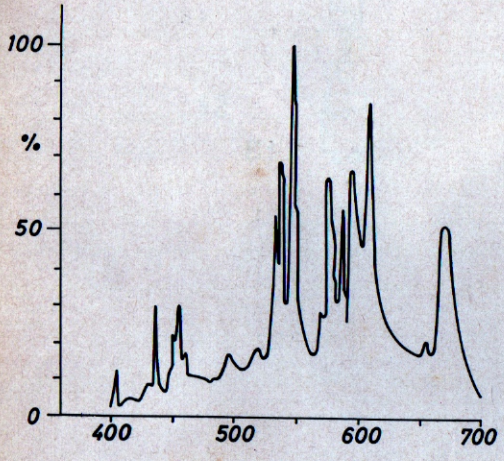


14

For color photomicrography with artificial-light film, we recommend the Lifa filter R 12 (manufacturer: Lichtfilterfabrik, Augsburg; in the United States, Kodak Wratten filter).

This lamp operates only on AC. Its light flickers in rhythm with the double line frequency and is therefore not suitable for cinematography (see XBO 150 W/1 lamp).

The CSI lamp is operated via the choke (39 26 27; VHW 200 f—2 b). After taking off the back of the housing, 50 or 60 cps can be selected. When this has been done, a black indicator dial should also be turned from the inside to show the correct frequency on the outside. At the rear is a round slip-on current selector with indicator window. This selector should be inserted so that the designation L 2 is visible (4.2 A).



15 Spectral emission of the CSI 250 W lamp

Before the bulb is inserted into the lamp housing, the diffusion disc should be swung out so the bulb will not hit it. This can be checked after the round cover at the back of the lamp housing has been removed. During operation, however, the cover must be firmly closed.

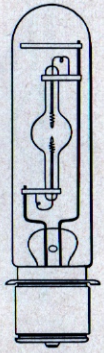
Due to its high operating pressure, this lamp must be operated only when its housing is closed.

To start the lamp, depress the starting key on the choke until the ignition hum stops (approx. 4 seconds). It serves no purpose to keep the key depressed for more than 10 seconds. Hot lamps must be allowed to cool off for a short while.

High-pressure Mercury Lamp HBO 75 W

This lamp serves for observations by fluorescent light, above all for studying bacteria for diagnostic purposes. Its luminance lies between that of the 12 V, 100 W low-voltage bulb and the carbon arc lamp. Its energy distribution corresponds to that of the high-pressure mercury lamp HBO 200 (Fig. 10).

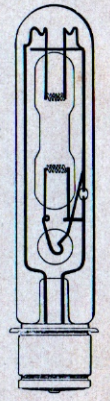
The high-pressure mercury lamp HBO 75 W starts operating as soon as the choke is switched on.



16

Sodium Spectral Bulb

For spectroscopic, polarimetric, interferometric and other measurements, this discharge lamp furnishes monochromatic light of $\lambda = 589$ mμ. Via a choke, it can only be connected to 220 or 240 V AC, 50 or 60 cps. A 400 VA step-up transformer is required for other AC voltages.



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Xenon Lamp XBO 150 W/1

This lamp operates on DC and is therefore suited for cinematography and photometry. It is connected to AC via a power supply (38 29 17).

The brightness is extremely great close to the cathode (cathode = lower, thin pole; anode = upper, thick pole) and decreases towards the anode. A concave mirror reflects the image of the source back into the light source so that two bright emission spots of the cathode will appear when the lamp is centered (page 17). By displacing the lamp socket, these emission spots are separated just far enough to create a uniformly illuminated area between them which serves as the illumination for microscopy.

The rear cover of the lamp housing carries a concave mirror which is only employed in conjunction with the xenon lamp; it would act as a disadvantage when used with other lamps.

A mirror (46 72 93) should be ordered together with the xenon lamp if the lamp is to be placed in an already available lamp housing that has no mirror. The retaining ring holding the mirror should not be too firmly tightened, as the latter must always have a certain amount of play.

The star-shaped cooling attachment screwed to the upper electrode dissipates the heat.



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Even when it is cold, the xenon lamp is under a pressure of 8 kg/cm². In view of the danger of explosion due to shock, impact or the like, the precautions indicated in the instructions which come with the lamp must be taken under all circumstances. The most important points are:

The lamp is supplied in a plastic protector. Before it is removed from the protector or taken out of the lamp housing, the operator should put on goggles with safety glass lenses, or a mask, and heavy leather gloves.

If the average life of the lamp of 1,200 hours is exceeded by 25%, the lamp should be replaced for reasons of safety. In this case, either return the lamp in its plastic protector to the manufacturer or follow the latter's instructions by wrapping it up in a heavy cloth and smashing it with a hammer.

Operating pressure of the lamp is between 30 and 40 kg/cm². The lamp should be turned on only when the housing is closed. Do not open the housing for at least 10 minutes after the lamp has been switched off.

The contacts on the electrodes must be clean. Check them from time to time and if they are oxidized, clean them with fine emery paper.

Inserting the bulb into the socket

Screw the base (lower part in Fig. 18) to the electrode which bears an identification mark on its shorter end, and tighten the lock screw at the bottom of the base with a coin. Then introduce the bulb into the socket in such a manner that the sealing of the bulb does not point in the direction of the lamp collector or the concave mirror. Tighten the oblique set screw in the socket with a screwdriver. The bulb is now firmly mounted. Screw the cooling attachment (35 mm high) with the cable to the upper electrode. While doing this, hold the electrode firmly (Fig. 11) to prevent stress on the quartz bulb.

Finally, introduce the socket and lamp with utmost caution into the housing.

Inserting bulbs into the housing

In all cases, first disconnect the lamp. Then proceed as follows:

1. Loosen the clamping screw and take the lamp base out of the housing.

2. Insert the bulb in the proper position and press it lightly into the spring-action socket, then turn it clockwise as far as it will go.
   For HBO 200 and XBO 150 lamps, see pages 10, 11, and 15.

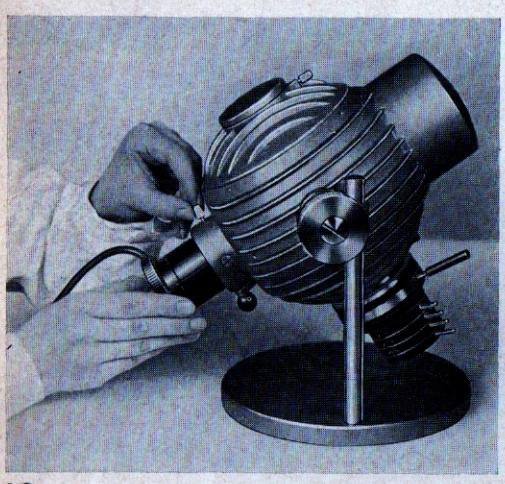
3. Remove fingerprints and other marks from the bulb with a clean cloth and, if necessary, with distilled water or alcohol so they will not burn in.

4. With clamping screw loose, insert the lamp socket with extreme care into the housing (Fig. 19) along a guide groove which, in some sockets, forms an angle.

   This angular "safety groove" prevents the lamp from falling out should the clamping screw have been loosened by accident.

   CSI lamp: First swing out the diffusion disc so it will not be touched by the lamp.

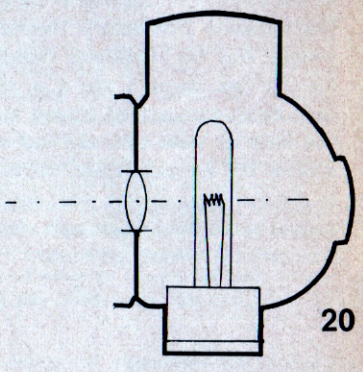
   Lock the lamp socket with clamping screw.



19 See items 1 and 4

Centering the light source

The light source must lie on the optical axis of the lamp collector so that all the light emitted by the radiant surface can reach the specimen. If the source is not centered and part of the radiant surface is covered by the collector mount, the microscopic image will show one-sided illumination and exhibit shadows. A centered light source is absolutely necessary for Koehler illumination. In the case of gas discharge lamps, the image of the light source is seen as a spot of light (xenon lamp, see page 14), while other light sources show the filament.



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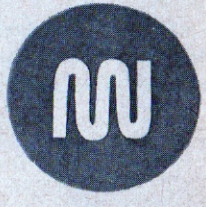
*Rigidly mounted illuminator**

Mount illuminator, swing out diffusion disc and open diaphragm half way. Capture the image of the light source on a sheet of paper held in front of the microscope mirror. The center of the image must coincide with the center of the mirror.

Illuminator on stand

For the sake of convenience rotate the illuminator through 90° so that the light exit opening points upwards. Swing out the diffusion disc and open the diaphragm half way. Swing out all filter holders except the one furthest away from the housing (marked IIII). Place a sheet of paper over the latter, loosen the collector, pull it out until the source is imaged on the paper and clamp collector again. The image should be concentric with the opening.



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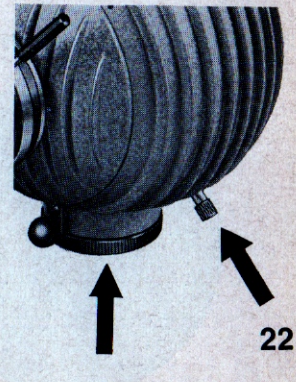
The source image can be centered by shifting the lamp socket vertically and turning the lateral adjusting screw (Fig. 22).



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* Here only the illuminator attached to the holder on the heavy base plate is meant. For use in conjunction with other instruments, follow instructions supplied with the microscope stand.

Adjusting the illumination

With STANDARD Microscopes, the optical axis of the condenser must first be centered in relation to the diaphragm opening in the microscope base (built-in base illuminator). The field diaphragm is imaged and the condenser centered in the usual manner (see items 5 and 6 — the image of the field diaphragm is then moved into the center of the field of view with the aid of the centering screws on the condenser carrier). The position of the centering screws must not be changed. The image of the field diaphragm should be centered then only by moving the mirror.

1. For rigid connection of the lamp housing to the microscope, attach it to the dovetail ring and clamp in position or fasten it on a separate stand which is conected to the microscope by a connecting bar.

2. Connect the illuminator to the power supply and switch it on. Attention: Follow the instructions on page 2, BEFORE ..... Point the illuminator on stand at the center of the microscope mirror. Push in the lamp collector, with diffusion disc swung out, until the source is imaged on the mirror (if necessary, hold a piece of paper in front of the mirror) and clamp the collector again.

   Make sure that the collector is pushed in far enough so that the light source will not be imaged on the filters (see page 17) which would destroy them in time.

3. Insert ground glass. The auxiliary lens II must be in the lower filter holder of the condenser carrier. Under no circumstances should the auxiliary lens I be in the light path at the same time.

4. Insert neutral filter (in the case of mercury lamps, barrier filter). Remove the eyepiece and, while looking into the tube, move the

A Field diaphragm not sharply focused



B Field diaphragm properly focused



mirror in such a manner that the objective aperture is as evenly filled with light as possible. Place the eyepiece back on.

5. Rack the condenser to its uppermost position. Focus the specimen with a low-power objective (10× or 16× magnification) disregarding the illumination for the moment (Fig. 23 A).

6. When working with Koehler illumination close the diaphragm of the illuminator, lower the condenser with the front lens swung in and open condenser (aperture) diaphragm half way until the field diaphragm is imaged together with the specimen (Fig. 23 B).

7. Center the image of the field diaphragm within the field of view by tilting or turning the microscope mirror (Fig. 23 C).

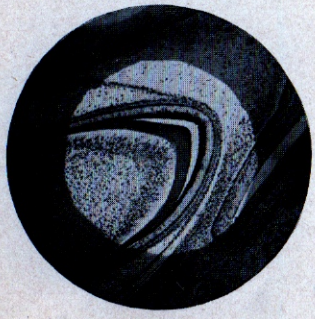
8. Open the field diaphragm until its image has just disappeared behind the limits of the field of view (Fig. 23 D). For oil immersion work open the diaphragm fully, unless an achromatic-aplanatic condenser is being used.

9. Adjust image contrast as desired, using the condenser (aperture) diaphragm. As a general rule, close the diaphragm only far enough to eliminate glare in the specimen.

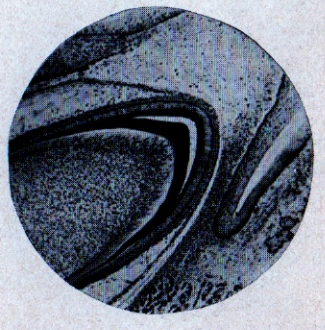
Check: To observe the image of the aperture diaphragm in the objective aperture either remove the eyepiece and watch with the naked eye, or look through the eyepiece with the OPTOVAR in Ph position. Only in exceptional cases should the diaphragm image be smaller than about ⅔ of the diameter of the objective aperture. On the other hand, it should never be larger than the full aperture of the objective, as this will cause glare. Under no circumstances should the aperture diaphragm be used to control the brightness of the microscopic image. This may be achieved either by varying the lamp voltage or by inserting gray filters in the light path.

10. After an exchange of objectives the settings described under 6 to 9 should be repeated. If in the case of low-power objectives this does not lead to satisfactory illumination of the field of view, it is necessary to swing out the front lens of the condenser. Then fully open the condenser iris, because contrast and resolution are now controlled exclusively by the diaphragm on the illuminator.

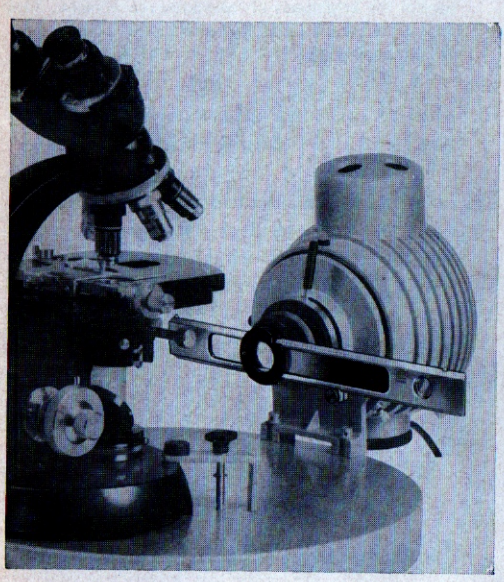
C Field diaphragm centered



D Field diaphragm open



23



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Gradation Filter Monochromator

This filter selects monochromatic light over a range of 400 to 700 mμ. It thus replaces a large set of filters. The monochromator is placed over the gradation filter holder (47 43 15) which takes the place of the quadruple filter holder. If very strong light sources (gas discharge lamps) are used, the heat protection CALFLEX filter must be inserted into the holding ring in front of the monochromator in the gradation filter holder.

Power supply units

Light source	220 V AC	Other AC voltages
Projection bulbs 220 V, 100 W 110 V, 100 W	direct	
		110 volts direct
Low-voltage bulb 12 V, 100 W	Transformer (39 25 27) 100-110-115-127-220-240 with taps 10-12-15 V, 50 . . . 60 cps, 135 VA, or regulating transformer with ammeter (39 25 33) 100-110-115-127-220-240/ 3 . . . 15 V, 50 . . . 60 cps, 120 VA	Same instrument as in column to the left; set required voltage
Sodium spectral bulb	Transformer (39 26 24) 220-240 V, 50-60 cps	In addition, step-up transformer (39 25 23) 100-110-115-127-240/220 V, 50 . . . 60 cps, 400 VA
High-pressure mercury lamp HBO 75 W	Choke (39 26 14) 220 V, 50 cps same as above, but for 60 cps (39 26 15)	For 240 volts: choke (39 26 16) 240 V, 50 cps; for other voltages: additional step-up transformer (39 25 23) 100-110-115-127-240/220 V, 50 . . . 60 cps, 400 VA
High-pressure mercury lamp HBO 200 W	Choke (39 26 22) 220 V, 50-60 cps	For 240 volts: choke (39 26 19), 240 V, 50 cps; for other voltages: additional step-up transformer (39 25 28), 100-110-115-127-240/220 V, 50 . . . 60 cps, 1000 VA
High-pressure mercury lamp HBO 200 W/4	Choke (39 26 27) 220-240 V, 50-60 cps	For 240 volts see left; for other voltages: additional step-up transformer (39 25 28) 100-110-115-127-240/220 V, 50 . . . 60 cps, 1000 VA
Halide-metal lamp CSI 250 W		
Xenon lamp XBO 150 W/1	Power supply (38 29 17) 100-110-115-127-220-240 V, 50-60 cps	Same instrument as in column to the left; set required voltage

The illustrations are not binding in every detail for the design of the instruments.

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