SM-LUX

Teaching and Laboratory Microscope

Leitz WETZLAR

Operating Instructions

512-113a/Engl.

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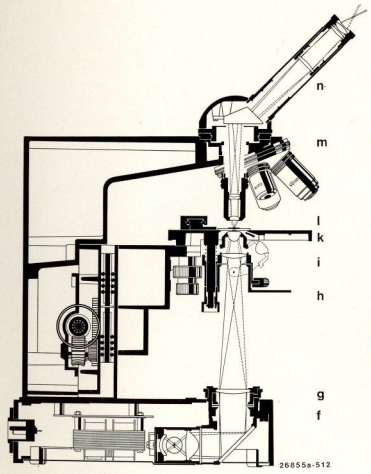
a Plug
b Transformer
c Low voltage lamp 6V 5W
d Condenser lens
e Deflecting mirror
f Field diaphragm
g Illuminating lens and filter support
h Aperture diaphragm
i Condenser
k Object stage
l Objective
m Revolving nosepiece
n Monocular tube



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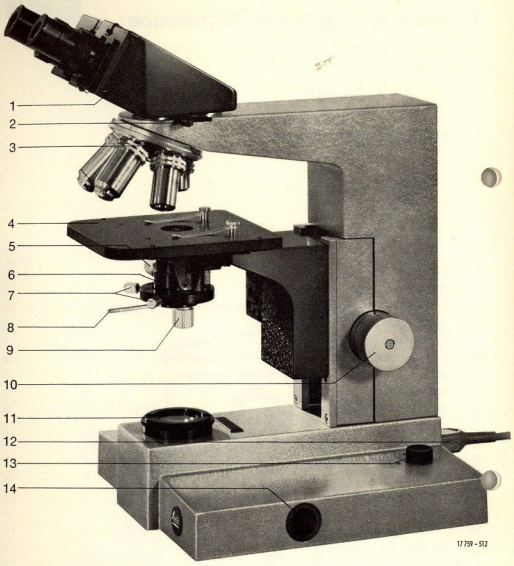


Fig. 1:
SM-LUX with binocular tube S and object stage No. 24a, with permanently mounted condenser

1 Binocular tube S
2 Tube changing lever
3 Revolving nosepiece with objectives
4 Object stage No. 24a with permanently mounted condenser
5 Lever for swing-out lens of condenser
6 Condenser
7 Centring screws
8 Aperture-stop lever
9 Control knob for vertical adjustment of condenser
10 Single control knob for coarse and fine focusing
11 Protective glass with field diaphragm
12 Mains cable
13 Control knob for transformer
14 Lamp socket

1 Technical description

11 Stand

Two different versions of the SM-LUX are available,

a) with interchangeable condenser (allowing the use of special phase-contrast or darkground condensers),
b) with permanently mounted condenser for brightfield work (a special insert makes certain darkground and phase contrast examinations possible).

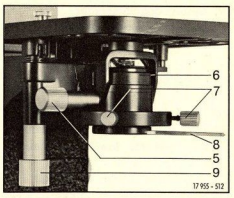


Fig. 2:
Object stage No. 24a with permanently mounted condenser

5 Lever for the swing-out lens
6 Condenser, permanently mounted
7 Centring screws
8 Aperture diaphragm lever
9 Vertical adjustment of condenser

12 Single-knob focusing

Dual controls (Fig. 1.10) are provided for coarse and fine focusing. They permit rapid and easy adjustment at any magnification. If the knob is turned in one direction only, it actuates the coarse adjustment; reversal of the sense of rotation automatically engages the fine adjustment for about one third of a revolution. Turning the knob beyond the fine-adjustment stop re-engages the coarse adjustment. One graduation interval on the knob is equivalent to 2 μm.

13 Illumination

The output of the 6V 10W illuminator built into the microscope base can be adjusted with the regulating knob of the built-in transformer. The lamp has a prefocus base. The illuminating beam is designed to satisfy Köhler's principle.

14 Condensers

The basic equipment includes either a permanently built-in or an interchangeable condenser No. 601 L. These condensers are primarily used in conjunction with achromatic objectives. If more highly corrected objectives are employed or if full use is to be made of the high performance of an immersion objective, the condenser top No. 001 may be exchanged for a top No. 002 or 010. Other condenser tops of long intercept distances will be found in the following table.

13 Object stages

Since the object stage is permanently mounted at the factory, orders should specify the desired type of stage. For further details, see list No. 512-96 on the SM-LUX.

14 Objectives and eyepieces

Five achromatic objectives of primary magnifications from 4:1 to 100:1 are available as basic optical equipment. For more critical work and especially for photomicrography we recommend our NPl achromats giving a perfectly flat image up to the edge of the field. All objectives are parfocal so that only slight refocusing with the fine adjustment is required when the magnification is to be changed. To protect both the front lens and the specimen, the medium and high-power objectives have a spring-loaded mount. The objectives have an adjustment length of 45mm. The objectives may also be employed for darkground work, provided the numerical aperture of the darkground condenser is larger than that of the objective. A funnel stop reducing the N.A. of the objective can be supplied for the 100/1.30 oil-immersion system.

Achromats 170/0.17/45mm

Engraved: Magnification/ Numerical aperture	Free working distance mm	Coverglass correction	Type of eyepiece
4/0.12	24.0	DO	P
10/0.25	7.6	DO	P
25/0.50	0.44	D	P
40/0.65	0.28	D	P
Oil 100/1.30	0.08	D	P

PERIPLAN® eyepieces	
Magnification	Field of view mm
6,3 x	18
8 x	16
NF 10 x	18

NPl flat-field achromats 170/0.17/45mm

Engraved: Magnification/ Numerical aperture	Free working distance mm	Coverglass correction	Type of eyepiece
NPl 6.3/0.20	2.0	DO	P
NPl 10/0.25	0.53	DO	P
NPl 16/0.40	0.50	D	P
NPl 25.0.50	0.38	D	P
NPl 40/0.65	0.15	D	P
NPl Öl 100/1.30	0.26	D	P

D: with 0.17mm coverglass
O: without coverglass; DO: for use with or without coverglass

The objectives described have been computed for optimum overall performance with PERIPLAN GF widefield eyepieces. With these eyepieces, field-of-view indices of up to 18 are obtained. In addition, high-point and pointer eyepieces are available on request.

M = eyepieces with adjustable eyelens

PERIPLAN wide-field eyepieces		High-point eyepieces	
Magnification	Field of view mm	Magnification	Field of view mm
GF 10 x	18	8 x	18
GF 10 x M	18	10 x	15
GF 12.5 x	18	10 x M	15
GF 12.5 x M	18		
GF 16 x	15		
GF 25 x	10		
GF 25 x M	10		
Graticule 10mm = 100 interv.			

15 Tubes

Three interchangeable tubes are available, each of which can be rotated through 360° on the stand.
Binocular tube S
Monocular tube P
Photo tube O
For details see the leaflet on the SM-LUX.

3 Initial operation

Switch on microscope illuminator at transformer (8.13). Focus the specimen:

Place specimen slide on stage. The specimen holder will accomodate slides from 26 x 26mm to 76 x 26mm. Swing in auxiliary condenser and raise the condenser fully.

Start with medium-power objective (preferably 10/0.25) and a 10x GF eyepiece for observation. Open aperture and field diaphragms.

When using the binocular body tube S set the interpupillary distance by moving the two eyepiece tubes further apart or closer together with both hands until the two microscope images coincide and the field of view is circular. Set the interpupillary distance thus determined (index on front plate of tube) on the two eyepiece tubes; for example, if the interpupillary distance was found to be 65, set both left and right-hand tube to the index 65 (see also Operating Instructions 513-106). Focus on the specimen by means of the combined coarse and fine adjustment.

To correct for faulty vision, proceed as follows: looking through the right-hand eyepiece with the right eye focus on is in focus there too; however, do not alter the fine adjustment. Check this setting after centring the condenser.

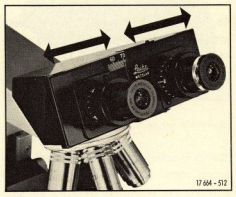


Fig. 9:
Binocular tube S

311 Centring the condenser

Close the field diaphragm halfway and focus the diaphragm image now visible in the microscope by vertical adjustment of the condenser. Move the diaphragm image into the centre of the field by turning the two centring screws

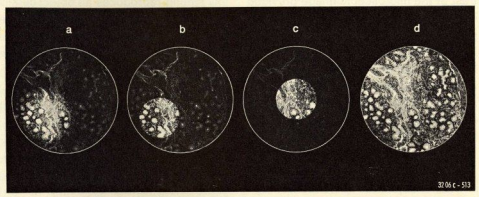
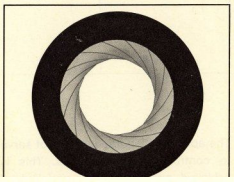


Fig. 10:
Centring the field diaphragm

a Field diaphragm fully closed.
b Image of field diaphragm focused.
c Diaphragm image centred.
d Field diaphragm opened far enough for edge of stop to disappear beyond field of view.

(1.7 or 5.7a). Open up the field diaphragm just far enough for its edge to disappear beyond the field of view.



Close the aperture diaphragm so that it leaves only two thirds of the objective aperture. To check this setting, proceed as follows:
Remove one of the eyepieces from the

The following general rules apply to the use of the diaphragms:
The field diaphragm protects the specimen against unnecessary heating and prevents flare. It should therefore be opened only as far as is necessary to clear the field of view. The aperture diaphragm determines resolution and contrast of the microscopic image provided it is smaller than the objective diaphragm.
To observe specimens of normal contrast, never stop the aperture diaphragm down beyond one third of the objective aperture. Closing it down further will quickly reduce the resolving power of the objective and thus impair the performance of the microscope.
For low-contrast specimens proceed as follows: first open the aperture diaphragm until it is just visible in the rear lens of the objective (first remove eyepiece). The apertures of the condenser and the objective are now identical. If this setting reproduces all object details satisfactorily, slowly close down the condenser diaphragm until the less contrasty structures stand out even better.

The use of the condenser No. 601 L and 001 is explained in the Table below.

N.A. of objective	Condenser top	Vertical adjustment of condenser
Larger than 0.25	Swung in	Roughly top position. Field diaphragm must be as sharply defined as possible.
Smaller than 0.25	Swung out	For visual work, roughly top position; image of field diaphragm need not be checked. For photomicrography, lower the condenser until the image of the field diaphragm is in focus.

The aperture diaphragm does not serve to control image brightness. This is achieved exclusively with variation of the lamp voltage or, with colour photomicrography, by means of neutral (grey) filters.

312 Change of magnification

A change of magnification requires only slight refocusing with the fine adjustment, since all the objectives of 45mm adjustment length are parfocal on the revolving nosepiece.

313 Oil immersion objectives

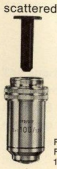
Oil immersion objectives are marked by the word "Oel" and a black ring round the lower edge of the mount. It is characteristic of an immersion objective that the refraction of rays on their emergence from the coverglass is reduced or completely eliminated and that in the case of larger aperture angles there is no total reflection at the upper side of the coverglass. As a result, rays of wider aperture angle have a chance to enter the microscope objective. This means a higher numerical aperture and thus higher resolution. The immersion oil used has roughly the same refractive index (n = 1.515) as the coverglass and the objective front lens. Focal length and working distance of an immersion objective are usually very short. This calls for certain precautions when oil immersion objectives are used. The coarse adjustment should be used only until the objective has dipped into the oil (check from one side). Then only the fine adjustment should be used for precise focusing under continuous visual observation. Ensure that the immersion oil is free from air bubbles. Only LEITZ immersion oil or, for fluorescence work, non-fluorescing LEITZ immersion oil should be used.
In general, the condenser No. 601 L will be adequate even for use with oil immersion systems. However, if full use is to be made of the large numerical aperture of the immersion objective, for instance for very fine structures, the aplanatic-achromatic condenser No. 610 L should be employed, which has an N.A. of 1.25. It is then necessary to apply oil also between the condenser top and the underside of the specimen slide.
After the examination, immersion oil should be carefully removed from all optical surfaces. This is best achieved with a soft cloth wetted with xylene. For polishing, use a dry chamois leather. Avoid any pressure on the objective front lens during cleaning. Never use alcohol or similar solvents to clean lens or condenser surfaces.

321 Transmitted-light darkground illumination

a) On stand with interchangeable condenser

For examinations in transmitted-light darkground in conjunction with the D 1.20 darkground condenser, immersion objectives of 45mm adjustment length are used together with funnel stops reducing the numerical aperture of the objective, which is too high for the D 1.20 darkground condenser, to less than the limiting aperture of the condenser (here 1.20). Otherwise part of the illuminating beam would be intercepted by the objective, thus degrading the darkground image. The D 1.20 darkground condenser may, of course, also be used in conjunction with high dry objectives.

The D 0.80 dry darkground condenser, which is easier to use, is recommended for darkground work with medium-power dry objectives, especially for serial examinations. For use with dry objectives of N.A. 0.65 an auxiliary diaphragm should be inserted into the D 0.80 condenser. This diaphragm will not affect the limiting aperture of the condenser; it is designed to intercept scattered light.



18 050 - 519

Fig. 12:
Funnel stop in connection with the 100/1.30 oil-immersion objective

Darkground procedure with D 1.20 or D 0.80 condenser

1. Before inserting the darkground condenser adjust the centring mounts roughly to central position using the centring screws.

Insert the darkground condenser fully into the dovetail carrier. Do not raise the condenser.

2. Apply a sufficiently large drop of immersion oil to the condenser surface.
3. Place the specimen on the stage and focus with the 10/0.25 objective. Should the image not be bright enough, slightly lower the condenser.

4. Raise the condenser, watching it from one side, until the drop of oil makes contact with the underside of the specimen slide (slide lights up briefly).
5. Looking through the tube, move the condenser further towards the slide until the light ring becomes a critically focused light spot. Move this into the centre of the field by means of the two centring screws. More accurate centring can be attained if the light ring seen first is centred to the edge of the field. Ensure proper focusing of the specimen.

6. Only now move an objective of higher power into the light path. Objectives of N.A. larger than 1.15 should first be provided with a suitable funnel stop.

7. When using the immersion objective, apply a drop of immersion oil also to the coverglass surface. Follow the directions for the use of the oil-immersion objective with transmitted-light brightfield illumination.

b) On stand with permanently mounted condenser

To make darkground work possible also with this type of stand, a special condenser insert has been developed. This can, however, be used only with objectives up to N.A. 0.65.

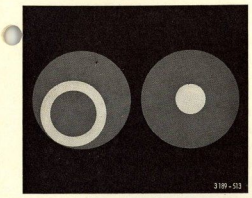


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Fig. 13:
Light ring and light spot during centration of darkground condenser

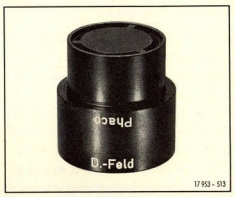

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Fig. 14:
Auxiliary stop for permanently mounted condenser, for darkground and phase contrast work

By analogy, the above darkground procedure also applies to the type D 0.80 dry darkground condenser. In this case of course no immersion oil is applied to the condenser or the specimen slide.

A suitable test object for darkground work is a specimen of spirilla from the mouth, which is always readily available. (Remove film from teeth with the aid of a pointed wooden applicator and mix it with a droplet of water on the slide. Cover it with a coverglass.

Darkground procedure

1. Slide the insert – with the engraving "D-Feld" facing down – into the condenser until it is flush with the condenser opening.
2. Swing in auxiliary lens and open aperture diaphragm.
3. Place specimen on stage and focus with 10/0.25 objective.
4. Slightly close field diaphragm and focus its image by vertical adjustment of condenser. Move image of field diaphragm into centre of field by means of centring screws. Open field diaphragm far enough for its image just to disappear beyond the field of view.

322 Phase contrast observation

a) With interchangeable condenser stand

Insert phase contrast condenser and screw phase contrast objectives into revolving nosepiece.

For further details on the use of the phase contrast equipment, see Operating Instructions 513-84.

b) With stand having permanently mounted condenser

(With the same insert as for darkground in the reverse position, phase contrast observations may be carried out with the Phaco 25/0.50 and Phaco 40/0.65 objectives.

1. Screw Phaco 20/0.50 and 40/0.65 objectives into revolving nosepiece.
2. Place (stained) brightfield specimen on stage and focus with 25/0.50 objective.
3. Close down field diaphragm and focus its image by vertical adjustment of condenser.
4. Move image of field diaphragm into centre of field by means of the two centring screws.
5. Open field and aperture diaphragms.
6. Slide insert – with engraving "Phaco" facing down – fully into condenser opening and swing out top lens.
7. Exchange brightfield specimen for phase specimen and, if necessary, refocus.

323 Measuring with the microscope

Linear measurements on the microscopic object are made with a measuring eyepiece (10mm usually divided into 100 intervals) by subjective observation through the inclined tube. For these measurements the micrometer value of the objective employed must be known. This value is defined as the distance in the object plane which, imaged by the objective, coincides with a graduation interval of the eyepiece graticule. Since the optical constants of the objectives are subject to slight variations, it is advisable to determine the micrometer value once for each of the objectives with a stage micrometer.

Example:
Determining the micrometer value with the aid of 2mm = 200 divisions stage micrometer and a measuring eyepiece with a micrometer disk of 10mm = 100 divisions.
Make the zero lines of the measuring eyepiece and stage micrometer coincide in the microscope. Read the micrometer value at the end of the eyepiece graduation without any variation in setting.
Examples: if 1.220mm on the stage micrometer are equivalent to 100 divisions on the eyepiece scale, the micrometer value is 1.220 : 100 = 0.01220mm = 12.20 μm. With low-power objectives, which do not show the graduation of the stage micrometer superimposed on the entire eyepiece graduation, only 10 eyepiece divisions are used for comparison. Thus if 0.36mm on the stage micrometer coincides with 10 eyepiece divisions, the micrometer value is 0.36 : 10 = 0.036mm = 36 μm. For very precise measurement with the microscope, a screw micrometer eyepiece should be used. For detailed information on this accessory, see leaflet 513-17.

4 Accessories

The versatility of the SM-LUX can be considerably increased with the accessories mentioned below:
Tracing device for tracing the contours of the microscopic image.
Heating stage for temperatures of up to 80° C.
Micro-attachment for LEICA® camera, for photographic recording on 35mm film.

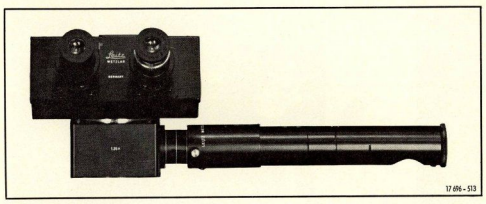

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Fig. 15:
Tracing device with attached tube S

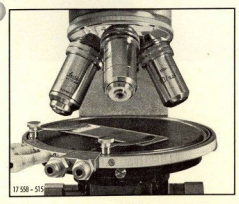

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Fig. 16:
Type 80 heating and cooling stage on SM-LUX

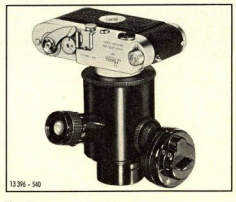

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Fig. 17:
Micro-attachment with LEICA camera

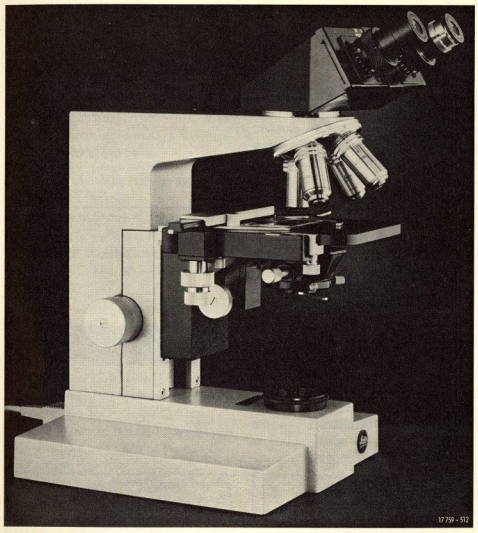


Fig. 18:
LEITZ SM-LUX microscope with interchangeable condenser

5 Care and maintenance

Always protect the microscope from dust with the aid of the plastic cover when not in use. From time to time clean the stand with a linen cloth or chamois leather. Never use alcohol as it attacks the enamel. Petrol on the other hand is very suitable for cleaning enameled parts.
Light marks on the stage can be removed with the aid of liquid paraffin or non-acid vaseline.
Special care should be taken in examinations involving acids or other corrosive chemicals. Direct contact between these chemicals and optical surfaces of the stand must be strictly avoided and all parts carefully cleaned after use.
Keep all optical components of the microscope meticulously clean. Remove dust from optical surfaces by wiping these with a fine, dry sable brush while lightly blowing over them. Should the dust adhere to the surface, use a clean linen cloth or a soft chamois leather wetted with a little distilled water. If even this will not remove the dust, use petrol or xylene, but never alcohol.

Magnification table (tube factor 1x)

Objective magnification	Final magnification with eyepiece	
	10 x	12.5 x
4	40	50
6.3	63	80
10	100	125
16	160	200
25	250	320
40	400	500
100	1000	1250

Do not unscrew the mounts of objectives for cleaning. If any internal defect should be discovered, return the objective to the factory for repair.
Take special care when cleaning coated surfaces. The external faces of the eyepieces and the front lenses of the objectives are provided with anti-reflection films of roughly the same hardness as glass. These should be cleaned with the same care as uncoated glass surfaces. In the interior of objectives and eyepieces, on the other hand, very soft coatings are employed on some surfaces, which may therefore be cleaned only by cautious blowing. This is why interior surfaces should not be cleaned by the user.
Proper care will preserve the high accuracy of your LEITZ microscope for many years. However, should it become necessary to check or repair a damaged instrument, please contact our nearest agents or the factory directly.

6 Filter Polarizing Equipment

The equipment consists of	Code No.
Polarizer in mount	513 173
Attachable analyser	513 358
Clamping holder	513 088
Accessories:	
λ-plate in mount	513 089
$\lambda/4$-plate in mount	513 090

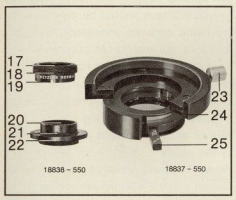


Fig. 19:
17 white indicator of the direction of polarization

Assembly

Attach filter holder 24 to the condenser and secure it with the clamping screw. Push polarizer 25 into the bottom slot. Remove the tube from the stand.
Screw up the clamping ring 22 of the assembly tube 20 to the locating pin 21. Screw the assembly tube 20 into the head of the stand as far as it will go and turn it back until the locating pin 21 is aligned in the east-west direction to the observer (see Fig. 21).
Secure assembly tube 20 by means of the clamping ring 22.
Place analyser 18 in mount in position and by slight pressure place the locating slot 19 on pin 21.

Replace the tube and lock it in position. The extinction position is obtained by rotation of the polarizer 25.

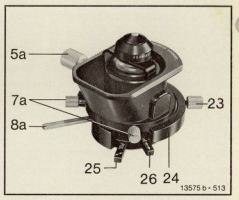
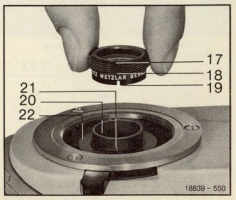


Fig. 20:
Achromatic swing-out condenser No. 601 with holder for polarizer and compensator attached

5a lever for swing-out lens
7a centring screws
8a lever for the aperture diaphragm (λ-plate)
26 compensator (λ-plate)

Fig. 21:
Attachment of the analyser



ERNST LEITZ GMBH D-6330 WETZLAR GERMANY
Subsidiary: Ernst Leitz (Canada) Ltd., Midland, Ontario

List 512-113a/Engl. Printed in W-Germany XII/73/LX/SD