Photometric Eyepiece

OKF-1

Brief Manual

1966

1. PURPOSE

The photometric eyepiece OKF-1 is purposed for measuring some optical constants related to reflective factor of minerals in polished microsections using ore microscope.

Principle of work of the eyepiece and measurement methods were developed by Russian professor I.S.Volynskiy.

The eyepiece works correctly at +10 to +40°C temperature and relative humidity of no more than 80%. Some eyepieces are manufactured by special drawings to work in tropical climate.

2. SPECIFICATIONS

Magnification	10x
Focal length	25mm
Linear field of view	11mm
Scale step of wedge	0.1mm
Light transmission limits of the wedge	0.2-1.0
Relative error of measurement result	10%
Dimensions	125x70x40mm
Weight	0.25kg

3. OPTICAL DIAGRAM AND MECHANISM

Picture 1 shows section of the photometric eyepiece. Optical design of the eyepiece includes a plate (1) with platinum wedge and scale, eye lens (2) of 10x Huygens eyepiece, glass plate (3) with index mark and collector lens (4) of the Huygens eyepiece.

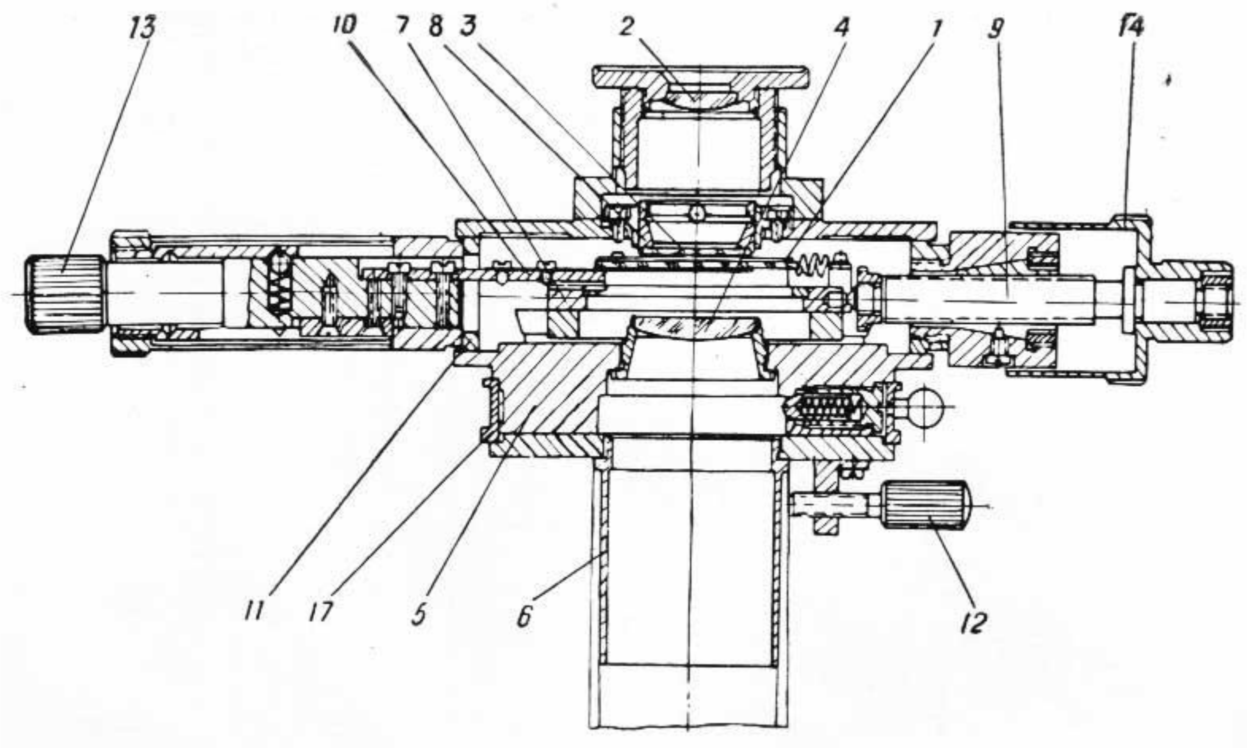
The photometric eyepiece consists of the base (5) with bushing (6); 10x Huygens eyepiece with dioptric adjustment; slide (7) with a plate (1) with platinum wedge and scale installed on it; housing (8) with index mark; screw (9) for the wedge movement; sliding diaphragm (10; body (11).

The photometric eyepiece is installed onto an ore microscope tube instead of regular eyepiece, and secured with screw (12). The platinum wedge, scale and index marks are situated in the focal plane of the eyepiece.

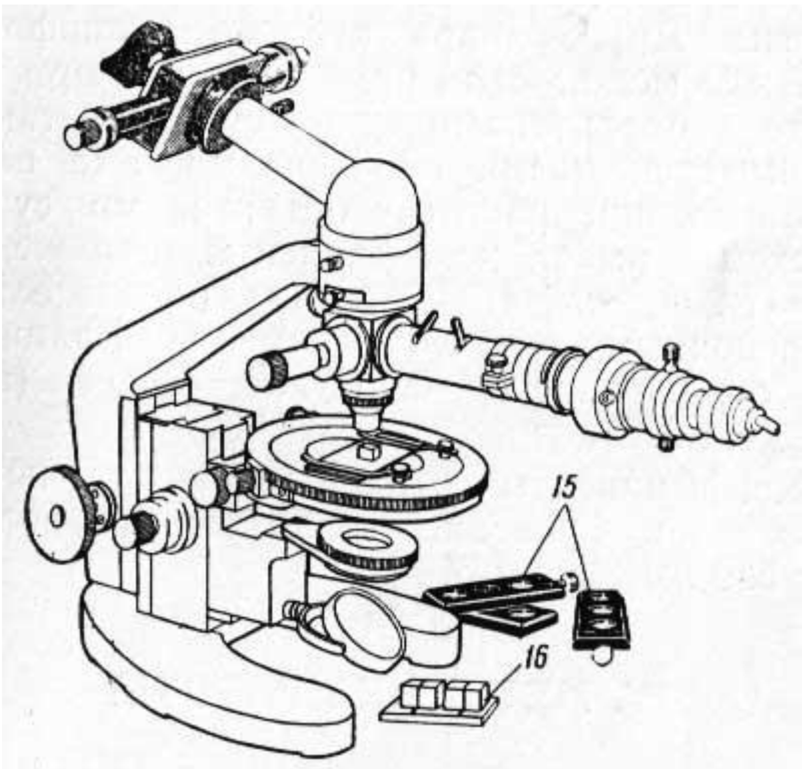
Sliding diaphragm (10) with a rectangular cut is placed below the plate (1). It is used to highlight a photometric area of the mineral. You can switch the diaphragm on and off with the handle (13). Knob (14) rotates the screw (9).

Framed interference filters (picture 2) are used for work in monochrome light. Each frame contains 3 filters. Optical characteristics of the filters are specified in their certificate.

Frame (15) with 3 filters is installed into slot of the eyepiece so that numbers face top. You may slide the frame with your hand and fix it in position of any of the filter. If you don't use filters, you should cover the slot with a cap (17) (picture 1).



Control plates (16) (picture 2) are used during learning the photometric eyepiece and to choose diameter of the aperture and field diaphragms.



Each plate (16) consists of 2 pairs of cubes of same size glued to one side of glass plate. The cubes are made of a glass with different refraction factors. Pair of cubes marked “1” has reflection factors R_1=4.20% and R_2=5.75%. This pair is recommended to be used with dry system objectives. Other pair marked “2” can be used both with dry and immersion objectives. For dry system it has reflection factors R_1=7.29% and R_2=8.20%. When immersion is used, reflection factors are R_1=0.46% and R_2=0.76% (if n_D=1.516).

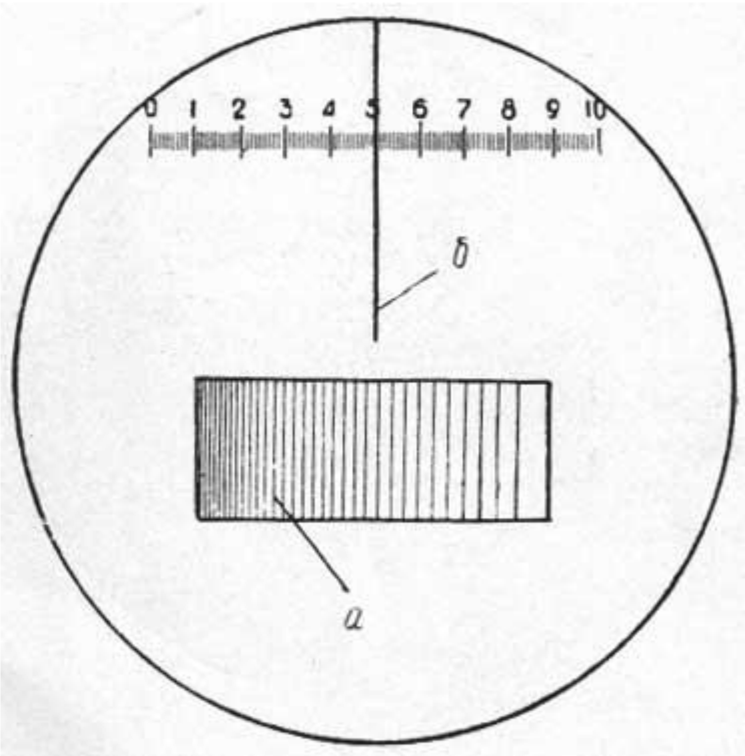
Reflective factors of the control plates are valid for λ=589nm wave length.

4. WORK TECHNIQUES

Principle of work

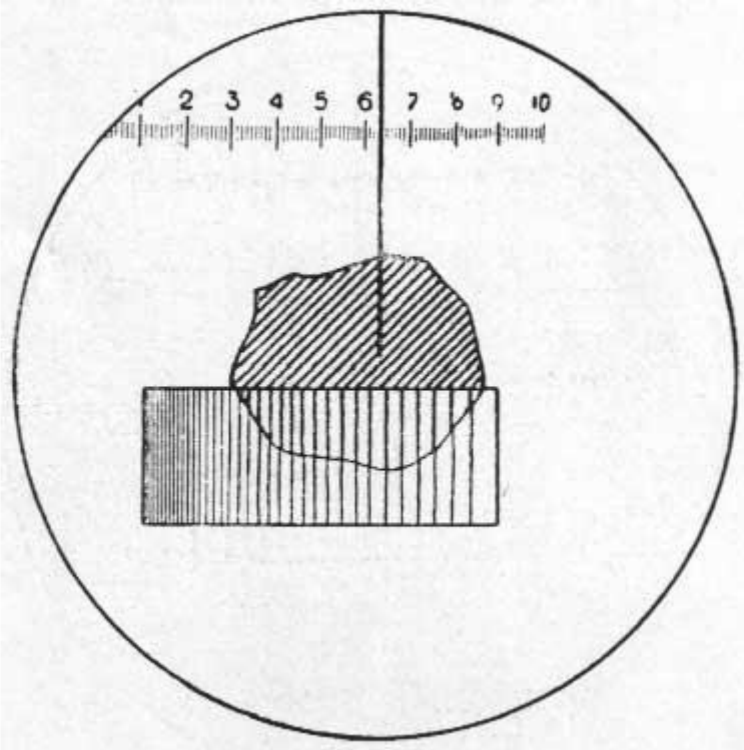
Measurements with the photometric eyepiece accomplished by method on balancing of illumination of images of test and etalon minerals in microsection when reflective factor of the etalon mineral is foreknown.

You may take any isotropy mineral without double reflection with known reflective factor in the spectrum.

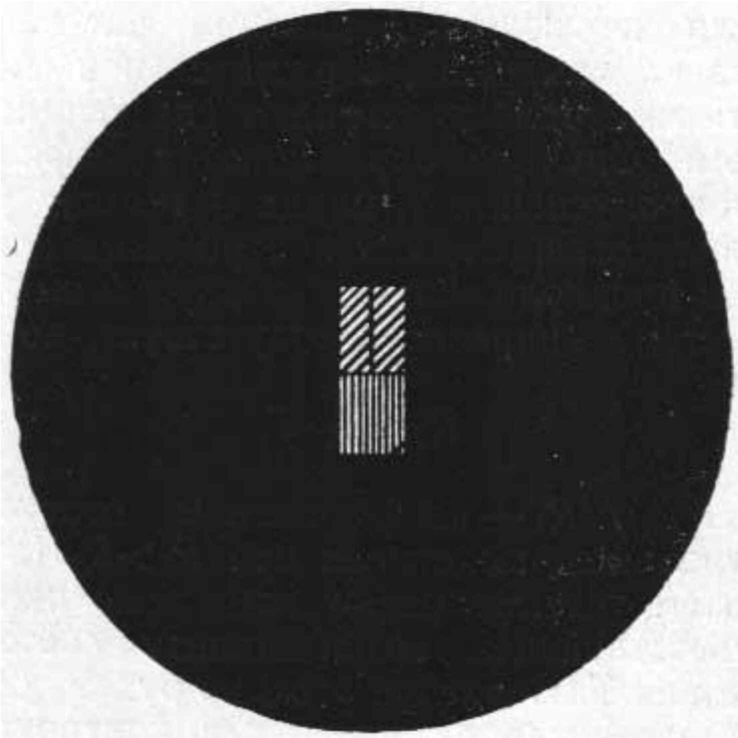


To make measurement, you should mount the photometric eyepiece onto a microscope tube and turn it into convenient position.

In the bottom half of the field of view (picture 3) you can see a photometric wedge (a) with variable light transmission factor along it (from 0.2 to 1.0). Top half contains 10mm long scale with 0.1mm step, and immovable index mark (b).



To make measurements, it is necessary to put linear part of accretion of 2 minerals (one of them has to be etalon mineral) into center of the field of view and align it with top border of the wedge. Brighter mineral should be place over the wedge as it shown on the picture 4. Then, you should balance brightness of both minerals by slow moving of the wedge with the diaphragm (10) in the field of view. Picture 5 shows what you should see in this case. Brightness in the area of the immovable index mark should be balanced most accurately.



To determine the wedge position, remove the diaphragm (10) (picture 1) from the field of view and write down the value on the scale against the index mark.

To avoid affection of the scattered light you should do following. Measure light transmission factor of the wedge T at the balanced position for the control plates with assumption of absence of scattered light using the equation:

$$R_2 = R_1 \cdot T$$

where R_2 and R_1 are reflective factors of the mineral sections, $R_1 > R_2$ (in %).

Then you should set the wedge into position corresponding to T. If brightness of the control plates isn't balanced, you should balance it adjusting diameter of the field and aperture diaphragms. Then you may proceed to measurements with test mineral.

If you switched an objective, diaphragm diameters should be adjusted again.

Reflective factor of the test mineral can be calculated by the following equation:

$$R_2 = R_1 \cdot T$$

where R_2 and R_1 are reflective factors of test and etalon minerals; T – light transmission factor of the wedge at the balanced brightness position.

Measurements for isotropy minerals should be made in usual light. For anisotropy minerals you should use polarized light without analyzer.

Measuring reflection factor in anisotropy double-reflecting minerals

During research of double-reflecting anisotropy minerals, two main reflection factors are determined – maximum Rg and minimum Rp.

Measurement should be done at area of most intense double reflection with suitable isotropy (or non-double-reflection) mineral.

Turn the microscope stage to achieve best illumination that corresponds to highest reflection factor Rg of the grain, loose the screw 12 (picture 1) and turn the photometric eyepiece to align line of the minerals accretion with the wedge border. Secure the eyepiece in this position and measure maximum reflection factor Rg as described earlier.

To measure minimal reflection factor Rp, it is necessary to turn the microscope stage 90°, turn the eyepiece to align the minerals accretion line with the wedge border, secure the eyepiece and make measurements. To measure relative factor of double reflection (Rg-p) of anisotropy minerals with photometric eyepiece it is necessary to choose a grain accretion with most intense double reflection. Position this area in the center of the field of view, align the eyepiece and balance brightness of both grains. Measured value (T) allow calculation of maximum reflection factor:

$$Rg - p = (Rg - Rp)/Rg = 1 - Rp/Rg = 1 - T$$

To measure dispersion of the reflective factor it is necessary to conduct series of measurements with each interference filter in frame (15) (picture 2).

Al measurements should be done in non-darkened room using an eye cup from the kit.

Surface of test mineral should be prepared carefully since non-polished scratches and dots will add error to the measurement results.

5. MAINTENANCE

The photometric eyepiece and its accessories should be stored in the wooden box.

The eyepiece should be stored in dry clean warn room. It is necessary to keep it clean and avoid damages. Storage box provides safe transportation.

It is forbidden to touch optical surfaces with fingers (eyepiece glass, filters, control plates).

Dust can be removed with soft brush. Also, you can use soft clean napkin moisture with gasoline a bit.

6. SPARE PARTS NUMBERS

#	Name	Code
1	Eyepiece mount screw	NUS 3x12 25.15.523
2	Turret spring	RPK-1 sb2
3	Filters “1”, “2”, “3” in frame	OKF-1 sb14
4	Filters “4”, “5”, “6” in frame	OKF-1 sb15
5	Filters “7”, “8”, “9” in frame	OKF-1 sb16

7. Certificate for interference filters

Mark of the frame	Factory number	Wave length at maximum transmission (λmax), nm	Half-width of the line in the maximum transmission (Δλ), nm	Transmission factor (Tmax), %
"1" "2" "3"	28-51 32-20 7-91	438 466 487	8 7 12	25 29 34
"4" "5" "6"	5-10 37-7 3-17	524 558 590	8 12 11	29.3 35 38
"7" "8" "9"	13-21 1-26 2-2	658 690 624	11 12 12	29.5 42 43

8. Certificate for platinum wedge

Scale value, mm	Ligh transmission factor (T), fraction of 1
0.1	
0.2	
0.3	
0.4	
0.5	
0.6	
0.7	
0.8	
0.9	
1.0	
1.2	170
1.4	176
1.6	183
1.8	193

Scale value, mm	Ligh transmission factor (T), fraction of 1
2.0	200
2.2	209
2.4	219
2.6	229
2.8	240
3.0	251
3.2	263
3.4	275
3.6	288
3.8	301
4.0	317
4.2	332
4.4	350
4.6	368

Scale value, mm	Ligh transmission factor (T), fraction of 1
4.8	387
5.0	408
5.2	431
5.4	457
5.6	484
5.8	510
5.0	532
6.2	554
6.4	578
6.6	598
6.8	622
6.9	-
7.0	645
7.1	-

Scale value, mm	Ligh transmission factor (T), fraction of 1
7.2	670
7.3	-
7.4	694
7.5	-
7.6	716
7.8	746
8.0	776
8.2	806
8.4	846
8.6	883
8.8	920
9.0	957
9.2	1000
9.4	-

Notes:

1. Transmission factor is in 0.2-1.0 range.
2. The transmission factors were measured in white light.
3. Maximum error is 0.6%.