Federal State Unitary Enterprise
Production Amalgamation
"Novosibirsk Instrument Making Plant"

BINOCULAR OBSERVATION DEVICE
PNB-3
“SOKOL”

Service manual

AL3.803.100 RE

CONTENTS

The device is subject to continuous development and improvement, consequently it may incorporate minor changes in detail from the information contained herein.

1 GENERAL DIRECTIONS

Binocular observation device PNB-3 (PNB-3-1) “Sokol” is designed for observation and determination of angular coordinates of objects observed from the stationary and temporary observation posts by day and night by the light of searchlights.

As distinct from PNB-3-1 device PNB-3 is complete with a tell-tale pipe, system of illumination and storage battery NK-13.

The device can operate in the open air at a temperature from minus 40 °C to 50 °C and relative humidity up to 80%.

For faultless operation of the device it is necessary to keep to the following rules:

- protect the device against impacts and damage;
- avoid touching the optical pieces with hands;
- remove dust, dirt and moisture from the optical pieces with a clean tissue;
- replace the desiccator in due time.

Caution! It is prohibited to direct the device if the brake flywheels 8 (Figure 1) are squeezed and 11 (Figure 3).

Prior to using the device one should study the rules of handling and the order of operation with the device.

2 TECHNICAL DATA

Table 1

Name of characteristics	Value	
	PNB-3	PNB-3-1
Observer's telescope:		
magnification, fold	10	
field of view, deg	7	
resolution in the centre of the field of view, ..."	5	
range of measuring the angles, deg:		
elevation	from minus 18 to 84	
the traversing angles	360	
Tell-tale pipe:		
magnification, fold	8	
field of view, deg	6	
resolution in the centre of the field of view, ..."	8	
Diopter setting of the eyepieces, D	±5	

Overal dimensions, mm:		
of the device without a tripod	450x445x420	
of the packing case	566x532x316	
Mass, kg, maximum:		
of the device	16.5	15.9
of the tripod	6.2	
of the system of illumination	0.44	-
of the accumulator in the housing	2	-
of the device packed	53.12	50

3 COMPLETE SET

Table 2

Name	Value	
	PNB-3	PNB-3-1
Observer's binoculars	1	1
Tell-tale pipe	1	-
Headrest	1	1
Storage battery	2	-
System of illumination	1	-
Tripod	1	1
Cover	1	1
Light filters for the binoculars	4	4

Light filters for the tell-tale pipe	1	-
Pipe connection	2	2
Caps for the eyepieces	2	2
Tissue	1	1
Wrench for the dehydrator plug	1	1
Screwdriver	1	1
Round level	1	1
Desiccator	2	2
Lamp MH2.5-0.4	6	-
Screw M2x6	4	4
Screw M2x8	2	2
Packing case	1	1
Bag for the accumulators	1	-
Box for the STA kit	1	1
Box for the light filters	1	1
Binocular observation device PNB-3. Service manual	1 1	1 -
Nickel-cadmium accumulators of NK-13 type. Maintenance instructions	1	-

4 SAFETY PRECAUTIONS

The device should be reliably secured at the seat of the tripod. Mount the tripod rigidly on the ground. Rocking of the device and tripod is not permitted.

5 DESIGN OF DEVICE

The binoculars consist of two telescopes with two parallel optical axes. The telescopes are connected with the help of a mechanism which allows to change the interpupillary distance by rotation of handwheel 14 (Figure 1).

There is an angle-measuring reticle (Figure 5) in the field of view of the right telescope of the binoculars. Positioned in the centre of the reticle are cross-hairs and five circumferences with radii expressed as divisions of the deflection: 0-05, 0-10, 015, 0-20, 0-30.

One division of the deflection is written as 0-01 and equal to 3.6.

The circumferences with radii of 0-05 and 0-15 are marked with dashes, the distance between the dashes is equal to 0-01. The circumferences with radii of 0-10, 0-20 and 0-30 are solid and figured. The cross-hairs positioned in the reticle centre has the lines of 0-02.5 long beginning from the centre. Along the horizontal and vertical diameters of every circumference there are the lines with a length of 0-01 marked from the inner side of the circumference. The changeable light filters (neutral and light-orange ones) are put on the eyepieces if necessary. The neutral light filters are used at bright light, for example, by sunny day, the light-orange ones are used when it is dull in order to increase the contrast of the object to be observed.

When sighting to the objects located in the sun, the sunlight may penetrate into the telescopes and make worse visibility. Therefore blinds 1 (Figure 2) are put on the casings of the telescopes to prevent penetration of sunshine. Besides, the blinds protect the objectives against possible scratches.

For easy observation the binocular telescope is provided with soft elastic rubber headrest 9 (Figure 3).

The headrest can move in the axial and transverse directions to align an observer's pupils and exit pupils of the device.

Dehydrator plugs 3 (Figure 2) intended for protection of the optical pieces inside the device against sweating are secured in the lugs positioned in the lower section of the telescopes. The action of the dehydrator plug is based on capacity of silica gel which constitutes the basic part of the plug to absorb moisture from the ambient air.

The silica gel condition is controlled through protective glasses: dry silicagel is bright blue; silica gel saturated with moisture is light-pink or dirty-white. The caps of the desiccators are provided with slots for a wrench which is used for their unscrewing in case of replacement.

When the inner surfaces of the optical pieces are sweated due to operation with the device at the high humidity of the ambient air one can desiccate the inner cavity of the device with dry air through the holes closed with caps 9 (Figure 1) and 2 (Figure 2).

Level 5 (Figure 3) serves for levelling the device. Three concentric circumferences are marked on the outer surface of the vial, they are used for determination of the device levelling accuracy. The level division value is 0-02.

The angles of sight in the vertical plane are read in the range from minus 18° (3-00) to plus 84° (14-00) from scale 7 and by the nonius secured rigidly in the bracket. Readings are taken from the scale through the port closed with a transparent plate inserted in cover 6. The scale is divided into one hundred seventy divisions, in so doing thirty divisions which designate negative angles of position (below the horizon) are painted red, and one hundred forty divisions which designate positive angles are painted white. A division value of every division is equal to 0-10. Every one hundred divisions are designated with figures 3, 2, 1, 0, 1, 2, 3, 4....14. The nonius allows of reading angles with accuracy up to 0-02.

The binoculars are locked by a position angle in the required position with the help of handwheel 8 (Figure 1).

There is a hole for lubrication of the axle on the right eye of the outer bracket. The hole is closed with screw 13.

For determination of angles of traverse there is the scale of traversing angles. The division value of every division is equal to 0-10. Every one hundred divisions are numerated with figures from 1 to 59. The nonius allows to take readings from the limb with accuracy of 0-02.

For rotation of the limb relative to the binocular telescope in orientation one makes use of a stopper. Handwheel 14 (Figure 3) of this stopper is positioned under the limb as well as three dogs 4 which help to rotate the limb through any angle when handwheel 14 is released.

The binoculars rotation about the vertical axis of the immovable base of the limb can be stopped by using handwheel 11 of the brake located in the lug of guide bushing 12.

The right telescope of the binoculars of device PNB-3 embodies a dove-tail guide secured with screws, it carries tell-tale pipe 11 (Figure 1). The tell-tale pipe 11 is secured on the dove-tail guide with the help of a hand-wheel. The upper section of the casing of the tell-tale pipe has approximate sight 8 (Figure 3) for aiming the device at the object, the sight consists of a front sight and a backsight.

The tell-tale pipe is a cranked telescopic monocular optical system. It consists of an objective, prism, eyepiece, reticle and light filter. The optical pieces of the tell-tale pipe and those of the binoculars are designed for the same purpose. The reticle of the tell-tale pipe is provided with cross-hairs, circumference of 0-20 radius and lines in the vertical and horizontal planes (at every 0-05 inside the circumference and at every 0-10 outside it), figure 6.

In operation with device PNB-3 at night one makes use of a lighting unit which consists of a distribution box, lamp-holders 12 (Figure 1), portable lamp 3, a plug coupling and wires. Accumulator 17 serves as a supply source of the system. For illumination of the reticle and scales one uses electric lamps of 2.5 V in the lamp-holders and portable lamp. With the help of a cut in the shape of a dove-tail and a catch one

lamp-holder is fastened on the clip attached to the drawtube of the right eyepiece of the binoculars, the other lamp-holder is fixed on the tell-tail pipe. If the lamp-holder is positioned correctly at the seat the catch enters the respective slot of the seat of the lamp-holder under the action of a spring and prevents it from coming off. The illumination brightness of the reticles is adjusted by a diaphragm with the help of screw 10 which moves along the guide slot of the lamp-holder casing.

Device PNB-3-1 has no system of illumination and tell-tale pipe.

The portable lamp is used for illumination of the outer scales. With the help of a holder the portable lamp is suspended on the tripod cramp. On pressing button 2 the lamp lights.

In the process of operation the device is mounted on the tripod. The basic parts of the tripod are head 5 (Figure 4), a pin and three adjustable legs 10.

To protect the tripod against damage in transportation one should put cap 7 on the tripod pin. There are cramps on two legs of the tripod for suspension of the housing which contains accumulators 9 and of the box which contains light filters 8. Prior to transportation of the device one should remove the accumulator and box and put them in the packing cases.

The tripod is carried with the aid of a shoulder belt 3. At intervals in operation,when it rains, snows, on the wind and in the dust-storm the device is to be covered with a cover which is tightened under the horizontal limb and a knot is made of a cord.

6 ORDER OF OPERATION

6.1 Setting of Device in Working Position

For setting the device in the working position it is necessary to mount rigidly the tripod on the ground, secure the tripod legs by screwing in screws 11 (Figure 4) and pedals up to the stop. Remove protective cap 7 from the tripod pin. Suspend storage battery 9 and box 8 with light filters on the tripod legs.

Remove the device from the packing case and with the released clamping screw 3 (Figure 3) of the bushing of the limb base, mount it on the tripod so that a key screwed in the tripod pin enters one of the slots of the limb base, after doing so secure the clamping screw.

Secure the tell-tale pipe on device PNB-3.

Clean the outer optical pieces of the device.

Mount the headrest on the device.

Fix the lamp-holders at the seats of the eyepieces of the binoculars and tell-tale pipe. In operation at night connect the plug coupling to accumulator 17 (Figure 1).

Level the device by a spherical level. Use the tripod legs for levelling. If the device is levelled properly the level bubble must not deviate for more than one division in rotation of the device in azimuth through 180°.

6.2 Preparation of Device for Operation

Remove the protective caps from the eyepieces and wipe the device and optical pieces with a tissue if necessary.

Set the eyepieces for the image sharpness by an observer's eyes. To perform this release the brakes of the laying for elevation and direction by using handwheels 8 (Figure 1) and 11 (Figure 3) and aim the device at any sharply-outlined object remoted at a distance of minimum 3 km.

Obtain a sharp image of the object to be observed in the eyepieces of both telescopes of the binoculars in turn for each eye by rotating the eyepiece rings (in doing so close the eyes in turn or darken the inlet ports of the device).

Memorize the settings on the diopter scales and use them later on for correct and quick setting of the eyepieces for the image sharpness for your eyes.

Set the eyepieces to the distance equal to the observer's interpupillary distance. To perform this obtain visibility of the whole field of view without cutting off its edges by rotating handwheel 14 (Figure 1) and observing through the device. The device field of view must be seen as one whole circle. Memorize the value of the interpupillary distance on scale 15 (against index 16) and use it later on in operation with the device. Check the setting of the headrest. The pupils of the observer's eyes must be aligned with the exit pupils of the device, and the device field of view must be observed without darkening or cutting of the edges.

The device should be oriented every time after setting the device in the working position, For orientation by a remote point release handwheels 8 (Figure 1) and 11 (Figure 3) of the device brakes and aim the reticle centre of the device at the chosen remote point. Secure the device against rotation by the horizon by screwing handwheel 11 in hard. Release handwheel 14 of the stopper of the limb of traversing angles and set the chosen traversing angle by the limb scale by rotation of the limb with the

use of dogs 4. Secure handwheel 14 of the stopper of the limb of the traversing angles. Release handwheel 11 of the device brake.

6.3 Operation with Device

The device is employed in the working position by two persons; an observer and a reader. When the object is detected with an unaided eye, the observer aims the device at the object by using an approximate sight and then observing through the binocular telescope brings the cross-hairs centre and the object image in coincidence and keeps the object image at the cross-hairs centre by rotation of the device using the handles. At the same time the reader takes readings of the values of the traversing angles and angles of elevation from the scales. Viewing through the tell-tale pipe the reader also sees to it whether the device is aimed at the object correctly if necessary.

Take readings of the scale of the horizontal limb by the scale of the limb and nonius (Figure 7).

If the zero line of the nonius is precisely aligned with any line of the limb scale one takes reading using only the zero line of the nonius and limb scale, because one knows a division value of the small division of the limb scale equal to ten divisions of the deflection as well as a division value of the large division equal to one hundred divisions of the deflection. One takes reading of hundreds of divisions of the deflection by the nearest figure of the limb scale positioned on the left side of the zero line of the nonius. Then one takes reading of the small divisions of the limb scale positioned between the line designated with this figure and the line coincident with the zero line of the nonius, thus determining the tens of divisions. After doing so the results are to be added. To facilitate taking reading every fifth line of the limb scale is elongated.

Example. The line of the scale limb positioned closely to the left side of the zero line of the nonius is designated with 59. The nineth line of the limb scale is aligned with the zero line of the nonius (if counting from the line designated with 59).

After addition of readings (59-00 + 0-90) one obtains 59-90 (Figure 8).

If the zero line of the nonius is not aligned with any limb line one takes reading to the nearest line of the limb scale on the left of the zero line of the nonius in the way mentioned above and determines the units of the deflection divisions by the nonius (with accuracy of the nearest even figure). To perform this one takes reading of the divisions from the zero line of the nonius to the nonius line which is aligned with any line of the limb scale and multiplies the read number of the divisions by two, as the division value of the nonius scale is equal to two divisions of the deflection (0-02). The obtained value is the value of correction in divisions of the deflection which is added to the result obtained before.

Example. It is required to take readings from the scale of the horizontal limb in compliance with figure 9. In the given case the large line of the limb scale nearest to the left of the zero line of the nonius is designated with 39. Prom this line one reads small divisions (seven) of the scale up to the zero line of the nonius. Add readings (39-00 + 0-70), obtain as a result 39-70. Then read the divisions from the zero line of the nonius to the nonius line coincident with the line of the limb scale (the third line). Multiply the result by 2, obtain 0-06. Add this result to readings (39-70 +0-06) obtained before and obtain the value of reading of the horizontal limb scale equal to 39-76 read with accuracy up to two deflection divisions.

The readings of the vertical limb scale (Figure 10) are taken from the scale and by the nonius like the readings of the horizontal limb and with the like accuracy. The positive angles are read by the scale lines and nonius painted white and the negative ones are read by the lines painted red. Besides, when taking readings of the positive angles one takes reading up to the line of the limb scale nearest to the right of the zero line of the nonius, and when taking readings of the negative angles one takes readings up to the limb scale line nearest to the left of the zero line of the nonius.

Example. It is required to determine the scale reading of the vertical limb in compliance with figure 11.

As the lines of the positive angles are positioned against the nonius the reading is taken up to the line of the limb scale nearest to the right of the zero line of the nonius. In the given case such line is the line of the limb scale designated with figure 2.

There are-no small divisions between the line designated with figure 2 and the zero line of the nonius, therefore the reading is +2-00. Take reading of the number of divisions from the zero line of the nonius up to the line of the positive nonius (painted white) coincident with any line of the limb scale. In the given case this in the first line, i.e. 0-02. Add the readings (2-00+0-02) and obtain the reading value of the vertical limb equal to 2-02 read with accuracy up to two divisions of the deflection.

The angles in the horizontal and vertical planes are measured by the subsequent aiming of the device at two points, the angular distance between them is determined by two readings of the aimed device.

When measuring angles of elevation one should take into consideration that in obtaining two readings of the similar signs the true value of the angle to be measured is equal to the difference in the largest and smallest readings, and when obtaining the readings of different signs the angle value is equal to the sum of their absolute values.

Determination of the range to the object by its angular value should be carried out in the following way:

- determine the angular value of the object by the scale of angles of elevation and by the scale of traversing angles;
- determine range D by the angular value of the object from the table. For drawing up such tables one uses formula:

$$R = \quad x\ 1{,}000\ ,$$

where: R - the range in metres;
S - the known size of the object in metres;
A - the angular value of the object in mils;
1,000 - the factor which converts the angular value in mils into the abstract value

7 MAINTENANCE

The faultless operation and longevity of the device service life depends to a considerable extent on its regular checking and maintenance.

During use of the device it is necessary to check its technical condition in due time with the aim of detection and elimination of its derangements. The technical condition of the device is characterized by its good order, completeness and readiness for use.

The list of operations in checking the device technical condition is given in tab. 3.

Table 3

What is checked, what tools, instruments and equipment are used. Method of checking	Technical requirements
1 The device completeness in compliance with the list of complete set. Check it by visual inspection	The complete set must be fully available
2 The outer appearance of the device and its parts, reliability of securing of units, mechanisms and parts. Check it by visual inspection, testing by hand and using tools from the single STA kit	No cracks, dents, traces of corrosion and other defects must be on the outer surfaces of the device. All units, mechanisms and parts must be reliably secured
3 Integrity of the lenses of the eyepieces and objectives, light filters and the condition of the level vial. Cleanness of the outer surfaces of the optical pieces. Check it by visual inspection	The optical pieces must be intact and clean
4 The condition of the headrest and reliability of its fastening. Checking is performed by visual inspection and testing by hand	The headrest must be in good order. The displacement of the headrest after clamping is not allowed
5 The condition of silica gel in desiccators. Check it by visual inspection	Silica gel must be bluish
6 Smoothness of extension of the tripod legs. Check it by testing by hand	The tripod legs must be extended over the whole lenght smoothly, without seizing
7 The operation of the mechanism of	The operation of the

setting the eyepieces by the observer's interpupillary distance. Checking is performed by rotation of handwheel 14 (Figure 1)	mechanism of setting the eyepieces by the interpupillary distance must be smooth, without seizing and ensure the setting of the interpupillary distance in the range from 59 to 72 mm
8 The run of the eyepieces and possibility of their setting in the rangeof the diopter scales. Checking is carried out by rotation of scales 10 (Figure 3)	The run of the eyepieces must be smooth, without clearance and seizing and setting to any value of the diopter scale must be ensured

Continuation of the tab. 3

What is checked, what tools, instruments and equipment are used. Method of checking	Technical requirements
9 The operation of the mechanisms of angles of elevation and traversing angles. Check it by rotation of the device around the horizontal and vertical axes with the use of handles 6 (Figure 1)	The rotation must be smooth, without jerks and seizing
10 The breaking devices. Checking is carried out by testing by hand	The braking devices must ensure reliable fixation

8 POSSIBLE DERANGEMENTS AND METHODS OF THEIR ELIMINATION

Table 4

Derangement, outer display and additional symptoms	Probable cause	Method of elimination
1 The terrain image is visible weakly through the device	Dust and dirt on the outer surfaces of the optical pieces	Wipe the outer surfaces of the optical pieces by using a tissue
	Sweating of the optical pieces	Blow the device with dry air. Check its tightness. Replace the desiccators with new ones
2 Silica gel in the desiccators becomes pink	Silica gel is saturated with moisture	Replace the desiccators with a new ones

3 The level bubble is not visible or is extended and exceeds the bounds of the middle lines of the vial	The level is out of order	Replace it with a fit one
4 The lamp fails to light	The lamp is burnt	Replace it with that in good order

9 RULES OF STORAGE

After operation with the device one should clean the outer surfaces of the optical pieces against dust and moisture, put caps on the eyepieces and put cover on the device or place the device in the packing case.

All the places of the device which are no bar to penetration of moisture and dust inside are filled up with special watertight putty, therefore it should be seen that this putty is always in good order. The unpainted parts of the device - the tripod pin, the headrest pin and so on - should be coated with a thin layer of grease to avoid corrosion.

The mechanical parts of the packing cases should be slightly greased to avoid rusting. All accessories and spare parts are to be put in their mortizes in the cases when in storage.

It is not permitted to store the device on the floor, near stoves, at the windows.

The premises where the device is stored must be dry and heated.

The air temperature in the premises must be not lower than 5 °C and relative humidity at a temperature of (25±10) °C must not exceed 70 %.

The tripod is stored together with the device complete set.

The alkaline accumulators are stored in compliance with the maintenance instructions on accumulators.

10 ACCEPTANCE CERTIFICATE

Binocular observation device PNB-3 (PNB-3-1), serial No. , is in compliance with technical requirements and found fit for service.

Date of issue _____

Signatures _____
(stamp)

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Supplement 1

RESTORATION OF ABSORBING CAPACITY OF SILICA GEL

For restoration of absorbing capacity of silica gel it is necessary to screw out the cap from the desiccator, pour silica gel in a clean metal vessel which is put on the heat source (an electric stove, coals of a bonfire and so on).

The direct contact of silica gel with the flame is to be avoided.

Restoration is carried out at a temperature of 120 °C for 16-20 h, i.e. until silica gel changes its colour lor an intensive-blue one.

Cool the restored silica gel in the closed vessel and pour it in the dehydrator plug, screw in the cap, screw the desiccator in the container.

A spare dehydrator plug without a protective container and the restored silica gel must not be exposed to the open air for more than two minutes to avoid saturation of silica gel with moisture from the surroundings.

Silica gel can be restored unlimitedly, in doing so its absorbing capacity is preserved.

However the service life of silica gel is decreased in case of its contamination.

Therefore in assembling and dismantling of the desiccator and restoration of silica gel one should handle it carefully, avoid touching it directly with hands and calcinating it in dusty premises.

Supplement 2

F I G U R E S