The working principle and design are described for a universal autocollimation angle meter, which is intended for checking various geodetic instruments (geodetic levels, theodolites), and also other instruments with small measurement ranges (levels and autocollimators). The basic mechanical characteristics are given.

Key words: autocollimator, geodetic level, theodolite, level, reflector, angle meter, level checker, mirror, eyepiece.

For several years, this organization has been producing autocollimation systems for checking geodetic levels and theodolites (LTCU). The equipment has passed state acceptance tests and has been included in the register of measuring instruments for Ukraine (U1785-03). Such instruments are used by the government survey bodies in many countries, including Belarus, Kazakhstan, and Russia. A new style of LTCU has now been developed, in which improvements have been made to certain parts and the functions have been extended, while the cost has been substantially reduced. In particular, the need for a foundation pillar is eliminated, because we have built a bench instrument, which in turn provides a highly rigid construction. Major changes have been made in the main part of the instrument, namely the autocollimation device for checking geodetic levels (LCU). The new modification under the designation AUPN-24 includes two major components: a device for reproducing the horizon line and a special rotating test stage, which can be used independently, e.g., to determine the errors of levels and in the joint determination of the errors of geodetic levels with compensators. Here I consider the features of the design and the main technical characteristics.

Figure 1 shows the system used in the AUPN-24; the working principle is to reproduce a sighting line parallel to the horizon line, by means of an autocollimator and corner-cube reflector, which is formed by the free surface of a liquid and a vertically placed mirror. The procedure for adjusting the device to reproduce the horizontal is as follows. The autocollimation sighting tube 2 with cube eyepiece adjusted to infinity is set at a certain angle to the free surface of the liquid in such a way that the light beam falls partly on that surface in vessel 3 and partly on the surface of mirror 4. When the angle between the horizontal liquid surface and the reflecting surface of the mirror is close to but not equal to 90°, the field of view in the autocollimator eyepiece has two images of an engraved mark, which are displaced in the vertical plane. One observes through the eyepiece and rotates the mirror around a horizontal axis to bring the two marks into coincidence. This indicates that the angle is 90° and consequently the reflecting surface of the mirror is vertical. Then the autocollimator 2 is transferred to the horizontal position and adjusted in such a way that its sighting axis is perpendicular to the plane of the mirror, and is consequently parallel to the horizontal plane. Mirror 4 is suspended on flat springs and covers only part of the autocollimator light beam (50% of the exit pupil area), while the remaining light flux passes to the side of the mirror, which allows one to observe the image of the mark in the eyepiece through the sighting tube of the geodetic instrument (geodetic level, theodolite, tacheometer, etc). The level 6 is set up on a special examination table 10 opposite the exit pupil.
of the autocollimator 2 and its sighting tube focused on infinity, which is brought into the horizontal position from the readings of the level on the tube. In that case, the field of view in the eyepiece of the level will show an image of the engraved mark for the autocollimator 2 as a luminous cross, whose horizontal branch should correspond with the horizontal filament in the level engraving.

If one sees a vertical shift in the horizontal wires, this means that the axis of the sighting tube in the level deviates from the horizontal plane by a certain angle (error angle), whose numerical value can be determined from the readings of the angle meter 5 (Fig. 1), which consists of a prismatic wedge in a cylindrical holder, whose crest is vertical. The holder with the prism can be rotated around the horizontal axis through ±70°, as a result of which the beam passing through the wedge is deflected in the vertical plane by ±20″. When one determines the error angle of a geodetic level, the holder in the angle meter is rotated to bring the horizontal wire in the autocollimator 2 into coincidence with that in the level. The error angle is read out from the scale on the holder for the wedge prism.

For convenience, there is the additional illuminator 1, which is installed opposite the input pupil of the autocollimator 2 eyepiece, a standard power supply with output voltage of 6.3 V, and a control unit, which enables one to regulate the current in the illumination lamp and the eyepiece, so one can vary the brightness of the images of the marker and cross wires as appropriate to the operator’s vision. The additional illumination allows one to check the setting of the eyepiece, which is one of the basic error sources. The design of this eyepiece provides for separate setting of the marker and the cross wires.