"OPTIKA" MICROSCOPE ADAPTATION FOR OPTICAL MEASUREMENTS AND USING COMPUTER

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Abstract: The paper describes several important specifications of the microscope "OPTIKA" from theTechnical Measurements and Dimensional Control Laboratory. Also, some devices for attachment and locking of different types of parts and machine elements on the table of the microscope are presented. Experimental measurements were made on microscope "OPTIKA" in optical and computer-aided version, and on the large workshop microscope, too. Finally, experimental results were compared and some conclusions have been drawn.

1. INTRODUCTION

The "OPTIKA" microscope has a measuring range of 25x25 mm and a measurement accuracy of 0.01 mm /division, due to the two depth micrometers used to move the table along the two XY directions. The measuring domain can be increased by using size blocks and the reading accuracy can reach up to 0.01 mm by coupling it to a computer and using an appropriate software, [1].

Exterior dimensions are usually measured with universal measuring instruments such as vernier callipers or micrometers. They are characterized by a specific measurement range and precision of measurement, [2].

The precision of the distance between bores axis is extremely important when tolerated because in these bores shafts will be fitted, with gears, cams, etc. mounted on. Currently, in the Technical Measurements and Dimensional Control Laboratory, for overall size small pieces, the workshop microscope equipped with dual image eyepiece head is used. This method is based on the principle of double image formation of each of the holes considered, when the center hole is not in the optical center of the microscope, [2].

Conical fittings are often used in engineering, despite the fact that they are complicated, both constructive and technologically and in terms of control.

As practical methods for measuring taper there are mentioned optical methods using microscopes: direct finder method and goniometrical method, [2]. The aim of the paper is to adapt the microscope "OPTIKA" for optical measurements and computer-aided measurements in order to determine the diameter of exterior cylindrical surfaces, the distance between the axes of conical bores and exterior tapered surfaces. To this end there have been conceived, designed and executed some elastic and prismatic devices, allowing locking of the types of mentioned parts and machine elements for dimensional measurements.

2. THE "OPTIKA" MICROSCOPE

The optical microscope was built to visualize objects with dimensional accuracy up to 0.1 mm, as well as to analyze details of macroscopic objects, which can not be perceived with the naked eye. Optical components placed above the object plane define the imaging system while optical components placed beneath the object plane define the lighting system. The lens near the object to analyze is the objective, while the lens system near the eye is the ocular.

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Fig. 1 shows the microscope "OPTIKA" from the Technical Measurements and Dimensional Control Laboratory. The main optical specifications are, [1]:

- 1 or 2 eyepieces WF10x;
- half-plane achromatic objective 4x N.A.;
- 40x magnification: 4x objective, 10x ocular;
- the stage X / Y;
- Halogen adjustable illuminator;
- Bulb: 6V 20W,;
- adjustable LED illuminator (20mA, 3.5V).



Figure 1: "OPTIKA" Microscope

Working with "OPTIKA" Microscope, [1], Fig. 1, of the Technical Measurements and Dimensional Control Laboratory, means completing the following succession:

- connecting the power cord plug to the microscope socket;

- positioning the piece to be measured on the microscope stage and in the object field;

- rotation of the eyepiece vane ring so that the pointer matches the interpupillary distance;

- sample image observing through the right eyepiece and focusing the image until it becomes clear.

3. WORKING DEVICES

The "OPTIKA" microscope is equipped with a turning stage with a scale rule graduated from 0 to 360 °. In addition, a circular vernier with 5 divisions, allowing angle measurements with precision of 12' is provided. This turning stage is placed on another stage having the possibility of moving in two mutually perpendicular directions XY, with two depth micrometers. Maximum stroke of the stage on the two coordinates direction is 25mm, with the possibility of increasing it to 50 mm by means of size blocks, while the accuracy of these displacements is 0.01 mm/division, [1].

It was necessary to provide a device to allow the positioning of (small dimensions) cylindrical parts in order to carry out optical and computer-aided measurements, [3]. This device is shown in Fig. 2 and consists of the following parts: support ring, prisms, locking screws, centering pins and spacer.



Figure 2: Prisms positioning device





An elastic device was conceived as well, designed and made for locking plate-type parts on the microscope stage, Fig. 3. The elements of the device are: centering-pin, spring clamp and locking screw. The double device ensures safer locking.

Finally, another device was necessary to allow locking of tapered parts and machine elements between centers, in order to carry out optical and computer-aided measurements. This device is shown in Fig. 4 and consists of the following parts: support ring, centering stand, centering tapered top, locking screws, centering pins and spacer.



Figure 4: Device for locking parts and machine elements between centres

4. EXPERIMENTAL RESULTS

A size block was used for calibration and gauging in the case of computer-aided measurements.

- There were measured parts (machine elements) for cylindrical and plane dimensions, using the devices with prisms and with elastic clamps, respectively. Measurements using the computer-aided techniques (Fig.5), using the optical system of the microscope and, finally using the digital micrometer, [4] were carried out.
- □ Three distances between the axes of holes made in a plate locked on the microscope stage using the elastic clamping device, were determined [5]. To this

end three measuring methods were used: "OPTIKA" microscope (computer aided), Fig. 6, "OPTIKA" microscope (with micrometers), large workshop microscope (double image eyepiece). Finally the results were compared.

For the tapered parts (conical machine elements) locked on the specific device between centers, four measuring methods were used: "OPTIKA" microscope (computer aided), Fig.7., "OPTIKA" microscope (with micrometers), large workshop microscope (direct finder method), large workshop microscope (goniometry method) and subsequently the results were compared, [6].







Figure 5: Computer-aided measurements: a) exterior diameters b) lengths



Figure 6: Measuring the distance between axes using the computer aided method for "OPTICA" microscope

5. CONCLUSIONS



Figure 7: Taper measurements using computer aided "OPTIKA" microscope

The locking devices with prisms, elastic clamps and locking between centers are fit with the purpose for which they were conceived, designed and built.

The two measuring methods of the shaft-type dimensions made with the "OPTIKA" microscope (with computer and micrometers) are validated by comparing the results obtained with digital micrometer. This comparison is obvious from the plots shown in Fig. 8, for cylinder shaft dimensions and in Fig 9 for plane shaft dimensions. Regarding the average values, they didn't vary, generally, with more than 0,02 mm from one method to another.



Figure 8: Comparative plot of the results obtained for cylindrical shaft type measurements

□ The two methods of measuring the distance between the axes of holes made with the "OPTIKA" microscope (computer-aided and with micrometers) are validated by comparing the results obtained with the microscope equipped with dual image eye-piece head. The illustrative plots are presented in Figure 10. The actual values of the results obtained with the two methods using the "OPTIKA" microscope are systematically greater than the ones obtained with the microscope with dual image eye-piece head. The value scattering also presents the same tendency. Regarding the average values, these didn't vary with more than 0,01 mm from one method to another.



Figure 9: Comparative plot of the results obtained for plane shaft type measurements



Figure 10: Comparative plot of results obtained for measuring the distance between the axes of holes



Figure 11: Comparative plot for results of measurements on tapered parts (conical machine elements)

□ The two methods concerning measurement of the tapering angle, using the "OPTIKA" microscope, (computer-aided and with micrometers) are validated by the comparison with the results obtained using the large workshop microscope (direct finder and goniometry method), the plots being presented in Figure 11. Concerning the average values, these didn't differ with more than 5' from one method to another (approximately 4%).

In conclusion the accuracy of the proposed method is comparable with other measurement methods, yet may be faster and more efficient in some practical situations.

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