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METHOD OF CONTROL OF A SHAPE OF ELIPSOIDAL REFLECTORS ACCORDING TO DEVELOPED STAND

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Usually, «reflector» in optics is a component part of a photometer with an efficient focus function of incoming light flux and with a following task of transferring it to a photosensitive element. This process has meaningful value, first of all, because of demands for a whole process of measuring during the experiments that requires extremely high accuracy, where the error is practically inadmissible, such as optics, lasers, aviation, astronomy, etc. Today, progressive development of modern technological solutions and capabilities of manufacture allows to use variety ways of production of reflectors, including the most popular such as using copying machines, CNC machines, methods based on replication process, printing on 3-D printers (with subsequent metal deposition on inner «working» surface of reflectors), and machines equipped with a special equipment [1].

Since the technology of obtaining reflectors is quite extensive therefore arises the question of their further control using a universal method of control of a shape of ellipsoidal reflectors. Therefore, for validation of recently manufactured reflectors for suitability and applicability; and for measuring basic optical characteristics of reflectors was developed a special technical equipment: system for control of parameters of the inner working surface of the mirror ellipsoid of rotation (one of the most common types among reflectors which are widely used in biomedical optics [2, 3]). The system is simple enough but effective and reliable. It allows to measure optical properties accurately and to perform other functions during the research or testing of ellipsoid in optical purposes.

The developed technical equipment consists of a source of radiation, an optical system, a coordinate photodetector and an prototype, which in this case is an ellipsoidal reflector.

Thus, a stand was designed according to this system [4], which allows to control and to determine the suitability of manufactured ellipsoid in workshops, factories and laboratories

Today, the problem of measurement and control of manufactured ellipsoid is not new, however still actual. The demand for control and measurement of the main optical characteristics of the reflectors, firstly, was determined in the late nineteenth and early twentieth centuries. Since then, many measurement tools have been appeared that allow to determine with certain precision all necessary optical parameters on the prototype, such as coefficient the transmission of light flux in the focuses of ellipsoid, however the designed compact system is unique, accurate and sophisticated with opportunity to adjust optical system for better result during verification, research and experiments.

During research in the field of optics, mainly, two features play fundamental role. First one is accuracy of quality of surface of any manufactured prototype that has to be on extremely high level as it is used in this field of science; another one is using of correct method of control and measurement of a prototype following all technical requirements precisely.

Accuracy of control of object determines not only of the quality of item, but also by a possibility of using the product for certain optical purposes.

The designed stand allows to control a shape of ellipsoidal reflectors and ellipsoids that are widely used in photometry to study the optical properties of mud and biological media.

The stand includes a source of radiation, an optical system, a coordinate photodetector and a prototype.

The source of radiation is a laser emitter, such as a He-Ne laser with a rated power of 2 mW at a wavelength of 632.8 nm and a diameter of a beam of 1.4 mm.

The optical system is presented in the form of a reflecting mirror, as well as the possibility of installing any lenses up to 8 pieces (if there is a demand during the research). The mirror is placed at an angle of 45 ° to the source of radiation and to the prototype with the ability to accurately adjust the mirror relevant to degree, minute and even second thanks to a rotating knob with a scale [5].

The advantage of the charge-coupled device (CCD) of the coordinate photodetector is the high metrological characteristics (accuracy) and the ability to transfer data to a personal computer (PC) for further processing in specially designed software for different analysis of a database (DB).

The coordinate photodetector belongs to the primary converters, the principle of which is based on the application of drift charge carriers. It is characterized by a large steepness of the coordinate characteristic, a large dispersion ability (units and even dozens of micrometers) for a short length of the linear coordinate area (up to 1 mm) [6].

In this case, as a prototype is an ellipsoidal reflector or other type of an optical research sample, such as ellipsoids or spheroids.

The principle of operation of the system is as follows: from the source of radiation through the optical system passes prefabricated beam of light, which later goes to the working surface of the reflector. In this case, the test sample is fixed in a special cartridge with the possibility of manual rotation, depending on the need to study certain surface of the reflector to which the radiation is directed. Directed radiation proceeds from one focal point of the reflector, reflects from the inner surface of reflector and falls into the second focus. Thus, the principle of the stand is based on the measurement and analysis of reflected light flux concentrating in the focus, from which it subsequently enters the coordinate photodetector and further it would transmit to the PC where it is processed and stored as a table in a DB.

The method of measurement, based on strictly following of safety precautions while working with lasers in laboratory rooms and research centers [7], contains seven next steps.

1. Preparatory. To check the whole equipment: a laser, a coordinate photodetector for serviceability. To wipe the elements of the optical system with a disposable soft paper cloth dampened with 70 % ethyl alcohol or another special liquid for optics.
2. Installation. To install and fix the test sample in a specially designed for this purpose cartridge. To check the possibility of smooth rotation of the reflector.
3. Power connection. To turn on PC and to run software. To supply with the power laser and a digital coordinate photo receiver.
4. Focusing. To direct the optical system in such a way that the light flux coming from the laser falls into the focus of the reflector. The angle of rotation of the mirror is determined by the scale. If necessary, to calibrate the laser and install additional lenses, but, firstly, TURN OFF THE LASER.
5. Experimental. To set the sample (special template) to measure the accuracy and suitability of the system.
6. Metric. To perform measurements of the prototype by rotating the cartridge with a hand.
7. Final. To save data to file on PC and to turn off laser power, PC and digital coordinate photodetector.

Further, to perform calculations using a special method of data processing in accordance with the aims of the research.

This stand with step-by-step instruction was developed in order to improve a process of verification of manufactured reflectors for validity. Moreover the designed system allows to simplify process of measure optical values using coordinate photodetector.

This stand can be used in training laboratories in universities, on factories, moreover in research centers.

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РАСЧЁТ ОПТИМАЛЬНОГО РАССТОЯНИЯ МЕЖДУ ОРОСИТЕЛЯМИ ДЛЯ ОБЕСПЕЧЕНИЯ НОРМАТИВНОЙ ИНТЕНСИВНОСТИ ПОДАЧИ ОГНЕТУШАЩЕГО ВЕЩЕСТВА

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В настоящее время при тушении спринклерной системой пожаротушения помещения существуют слепые зоны (мертвые зоны). Слепая зона (мертвая зона) – это небольшая площадь помещения, в которой не соблюдается требуемая интенсивность подачи огнетушащего вещества (ОТВ) от одного оросителя (рисунок 1).

Данная ситуация противоречит пункту 6.7 ТКП 45-2.02-317-2018 [1]. Требуемую интенсивность орошения спринклерной установкой пожаротушения следует предусматривать каждым оросителем в каждой точке защищаемой площади (без учёта суммирования интенсивностей на пересекающихся участках защищаемой площади соседними оросителями с учётом фактических карт орошения для обеспечения нормативной интенсивности). Введённый в действие на территории Республике Беларусь ТКП EN 12845:2015 [2], который идентичен международному стандарту EN 12845:2015 [3], имеет ряд недоработок. Единицы