where F_M, – the area of the researched sample of material, m^2; a and b – constructive coefficients; ΔP_{ND} – pressure differential on the narrowing device, Pa; T_{ND} – air temperature, passing through the narrowing device, K.

For the purpose of practical approbation of the offered technique of a measure definition of heat-protective properties on the developed automated device the pilot studies of clothing materials are conducted. Objects of researches were the materials used for manufacture of fighting clothes of firefighters and their packages.

The measure values of heat-protective properties received with use of the developed technique were compared to the values determined by a technique, standard for materials of fighting clothes of the firefighter (according to STB 1971-2009 and GOST 12088-77).

The analysis of the received results allows to mark that the error of determination of values of coefficient of thermal conduction and thermal resistance by the offered method does not exceed 6 %, and coefficient of air permeability – 10 %.

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INVESTIGATION OF THE ACCURACY OF LOCATION BASED ON LOCATORS

ИССЛЕДОВАНИЕ ТОЧНОСТИ БАЗИРОВАНИЯ ПО ОРИЕНТИРАМ

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Key words: *location, precision, stitching, zigzag, shoe upper, appliqué, control program.*

Abstract. *The article examines the experiment on the study of the accuracy of location of details of shoes according to the locators. The results are used in the development of an automated technology for applying applique to the details of upper shoe in a zigzag pattern.*

With the automated execution of the operation of applying the applications to details of upper shoe, the movement of the semi-finished product is carried out in two coordinates according to the specified control program in a special technological equipment-cassette.

One of the auxiliary operations of the technological process is the completion of the rigging, that is placement of the details of the top of the shoe and details of the application in the cassette.

When placing parts, it is necessary to ensure the required accuracy of their location relative to the cassette and relative to each other.

The accuracy of laying the connecting stitch depends on the accuracy of the details.

Traditionally, the dimensions of the nests for laying the details of the application correspond to the dimensions of the parts.

The details of the application fit tightly into the cassette sockets, location is carried out along the contour of the nests.

Such a method of locating requires precise manufacturing of rigging, while for each size of application it is required to produce a separate cassette, which increases the cost of technology.

The task was set for developing an automated technology to make the tooling more versatile, to simplify the process of placing the details of shoes and application parts in the cassette.

It is suggested to make nests in a cassette for placing details of an application of a larger size than the dimensions of parts, with contours, equidistant contours of parts.

The locating is carried out on the locators - edges of the nests.

To assess the accuracy of basing on locators, an experiment was conducted.

Plastic model cassette was made of two glued together plates.

The lower plate is solid, and the upper plate has nests in the form of circles with diameters of 53.55 mm and 39.73 mm.

Specially made cutters on a cutting press made of genuine leather cut down ten pieces, the diameters of which are smaller than the diameter of the nests, and are respectively 38.13 mm and 29.73 mm.

An experiment for estimating the accuracy of basing by reference points was carried out for a socket with a diameter of 53.55 mm and parts of 38.13 mm and for a socket with a diameter of 39.73 mm and parts of 29.73 mm.

On the underside of each part, a rubber glue was applied and the part was pasted along the center of the corresponding socket, being oriented along its edges.

After that, the cassette model with the part was scanned.

Twenty images in a raster format were obtained.

The type of raster images is shown in Figure 1. In Figure 1, the following are indicated: 1-upper plate, 2-piece application, 3-circle for contrast, 4-gap between the part of application and the edge of the socket, S-gap value.

The resulting images were converted to a vector form.

Relative to the center of the nests in the digitized images, straight lines are constructed every 10 degrees.

Figure 2 shows the digitized contour of socket 1, the contour of detail 2 and lines 3 constructed.

After this, the function "trimming" the extra elements of straight lines up to the segments is performed.

The resulting image is shown in Figure 3. Figure 3 shows: 1- contour of the socket, 2-part contour, 3-segments.

On the lengths of the segments, the error of location on the locators was evaluated.

An algorithm is developed that automatically calculates the lengths of segments enclosed between circles 1 and 2, forms a database from the values of the lengths of the segments, and performs their statistical processing.

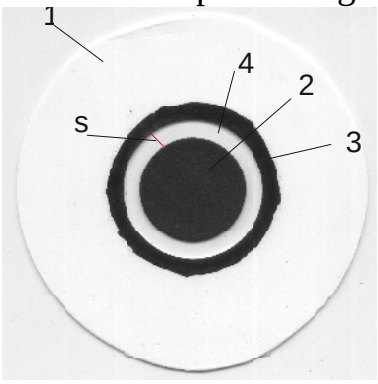

Figure 1 – Bitmap image

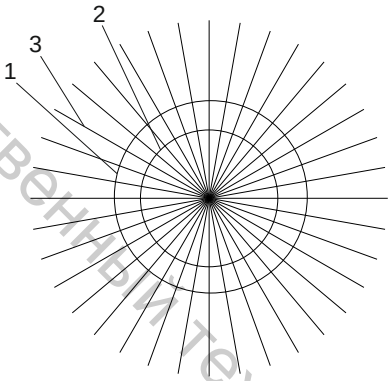

Figure 2 – Vector image

The results of the experiment for a larger diameter piece are shown in the graph in Figure 4, for a smaller diameter part, in Figure 5.

The gaps for the measurements taken are plotted from the line corresponding to the ideal gap size (for a socket and a larger diameter piece, 7.71 mm, for nests and parts of a smaller diameter - 5 mm).

The processed results of the experiment are summarized in Table 1.

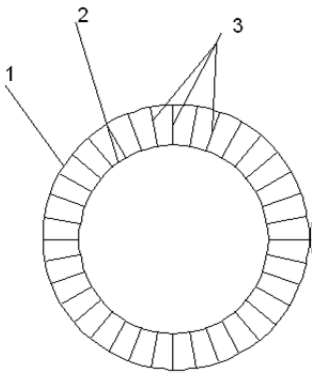

Figure 3 – Processed image

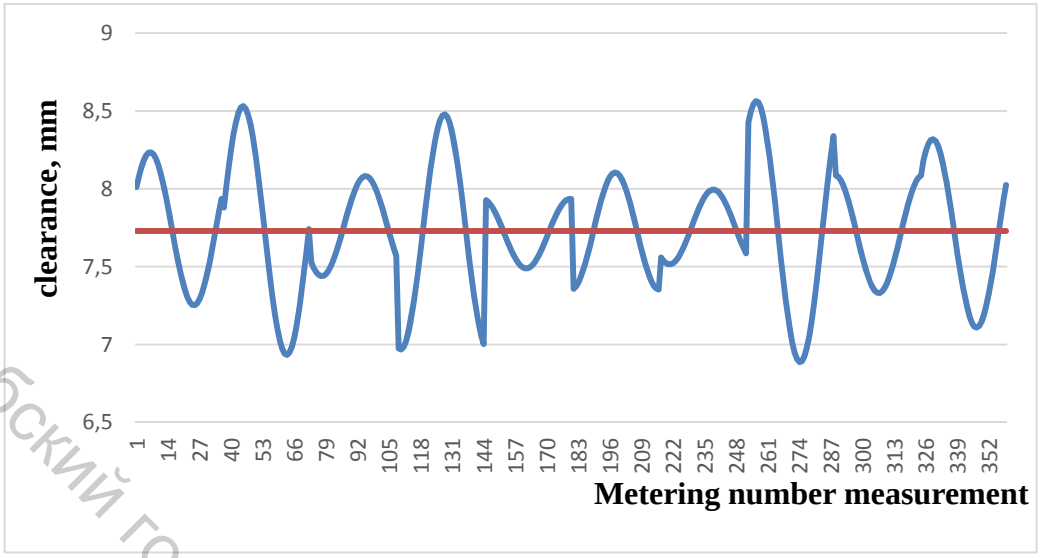

Figure 4 – Clearance for a part with a diameter of 38.13 mm

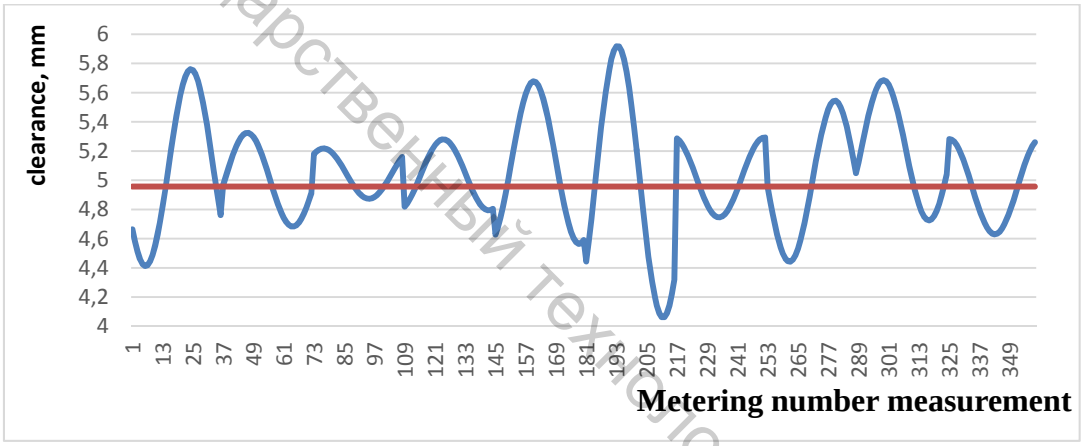

Figure 5 – Backlash for part with a diameter of 29.73 mm

Table 1 – Results of the experiment

Characteristics	Clearance error for part 38.13 mm	Clearance error for part 29.73 mm
Average	0.3203	0.297598
Minimum	0.0011	0.0006
Maximum	0.8426	0.9611

The experiment showed that the maximum error in basing by reference points is 0.96 mm. The magnitude of the error should be taken into account when programming a contour of a zigzag stitch for applying the application, so that neighboring needle punctures are always on different sides of the edge of the application part.