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«Research of microdeformation and stress in details of agricultural machines by implementing holography»

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Analysis of the literature has shown that the study of the processes passing with the destruction of surfaces of the limiting state must be carried out in a complex combination of two types of optical interferometry. This is due to the special possibilities of using each of the marked types of control for a specific type of research. Computer holography makes it possible to register changes in the surface at low, not limiting loads, which pass at low rates of change in the state of the surface. The image of a deformed body, represented in the form of colored interference fields, is recorded in the computer memory. In the second case of holography, the object is captured in three-dimensional imaged on a film or glass photographic plate along with interference lines. It is used to study high-speed dynamic processes, sometimes associated with the destruction of the surface or the entire part. The principle of operation of each type of holography is based on the double exposure method, when the body is observed before and after the application of the load. At the same time, changes in the state of the surface of the part are measured by comparing each of its sections with its changed state. A defect or damage to a part manifests itself in a local anomalous placement of interference fringes. In the case of computer holography, these are colored stripes (each color corresponds to a certain amount of deformation), in another case, these are black and white stripes.
Solution methods

**Table.** Mechanical load when examining real parts.

| Part name, material                                      | Mechanical load type |
|----------------------------------------------------------|----------------------|
| Internal combustion engine cylinder block, cast iron     | $F_1$ (N) $F_2$ (N) $F_3$ (N) $M_1$ (N m) |
| Internal combustion engine piston pin, steel             | - 800-900 750-900 80-100 |
| Piston, aluminum                                         | 850-1100 500-620 - - |
| Milk tap, steel                                          | 780-900 - 600-680 40-60 |
| Cover, polyamide                                         | 150-200 - 18-22 - |
| Adapter connector, carbon fiber                          | 30-34 25-27 18-20 - |
| Reducing sleeve, metal polymer                           | 65-70 - 45-52 - |

$M = f(X, Y) = (-1.0813 + 0.0104 \cdot X + 0.0255 \cdot Y - 0.6 \cdot X^2 - 0.0002 \cdot X \cdot Y) \times \times (10 - 0.0097 \cdot X - 0.0081 \cdot Y + 1.139 \cdot X^2 - 0.5 \cdot Y^2)^{-1},$

where $M$ – microdeformations, microns, $X, Y$ – coordinates on the surface of the hologram, mm.

**Figure.** Mathematical model of the process of microdeformation of the ploughshare surface at its allowable load.
• The important feature of computer holograms is that they provide information about the distribution of microdeformations on the surface of the part being studied. It is possible to study the physical processes of microdeformation not discrete, point by point, but integrally, assessing the state of the entire surface.

• The number of component models of the general description depended on the required accuracy given in advance, with an error of not more than $\beta = 0.1-0.3$.

• Analysis of the correlation equation for a part with an existing defect shows that computer holography with a high degree of reliability describes the physical process, where: $G^2 = 0.877$ at $G^2 = 1 \Rightarrow \text{max}$; $DF \ Adj \ r^2 = 0.867$ at $DF \ Adj \ r^2 = 1 \Rightarrow \text{max}$. This indicates the adequacy of the result to the real process. The hologram has a corresponding distortion related to the presence of the defect found. Characteristic peaks and troughs on the hologram characterize the presence, structure, and to some extent, the magnitude and nature of the subsurface defect: in our case, a crack, which significantly reduces the operational reliability of the working surface of the part.
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