Calculation of Tolerances of Landings with A Gap by Software

Косимова Замира Медатовна — Senior Lecturer of the Department of Mechanical Engineering and Automation, Fergana polytechnic institute, Fergana, Uzbekistan
z.qosimova@ferpi.uz

Uraimov Mukhammaddiyor Bahodir o'g'li — Fergana polytechnic institute, 2nd year student
muhammaddiyor503@gmail.com

ABSTRACT

This article discusses the reduction of time when calculating the tolerances of landings with a gap. Computer software for calculating landings with a gap can be used in the educational process, in production when calculating the design in design departments, when compiling the technological process of machining parts and assembling structures.

Keywords: landing with a gap, tolerance, software, analysis, calculation, upper deviation, lower deviation, automation.

Modern technologies have long been confidently included in our daily life and mechanical engineering is no exception.

Automation of design and calculations is required at all stages of production - from the choice of material to the final stage of manufacturing a part or machine. Computer software facilitates and accelerates work, expands capabilities, ensures time efficiency, data compatibility, consistency and timely updating, unification and standardization of design, technological, production, marketing, operational documentation.

The calculation of plantings affects the manufacture of products and their interchangeability.

Interchangeability of products (machines, devices, mechanisms, etc.), their parts or other types of products (raw materials, materials) is their property equivalent to replace when using any set of products, their parts or other products with another of the same type. In general, there is a distinction between interchangeability:

– complete;

– partial (not complete).

The most commonly used is complete interchangeability, which ensures compatibility of non-standard assembly or replacement during repair of any parts or products independently manufactured with a given accuracy. Complete interchangeability is possible only when the dimensions, shape, element and other qualitative and quantitative parameters of parts and products are within the specified limits and meet the established technical requirements.

The fit is called the nature of the connection of the parts, determined by the size of the gaps or tightnesses obtained in it.

Depending on the maximum dimensions of the hole and shaft, the fit can be with a gap, with tension or transitional.

Gap landings are designed for movable and fixed joints. In movable joints, the gap serves to ensure freedom of movement, placement of the lubricant layer, compensation for temperature deformations, as well as compensation for deviations in the shape and location of surfaces, assembly errors, etc.

For the most critical joints that must operate under conditions of liquid friction, the gaps are calculated based on the hydrodynamic theory of friction (for plain bearings). In cases where the connection is allowed to work in conditions of semi-liquid, semi-dry or dry friction, the choice of plantings is most often carried out by analogy with the plantings of well-known well-working compounds (analog method).

In fixed joints, landing with a gap is used to ensure unhindered assembly of parts. Their relative immobility is provided by additional fastening with dowels, screws, bolts, pins. The choice of landing in this case is made in such a way that the smallest gap provides compensation for deviations in the shape and location of the mating surfaces.

Landings - $\frac{H}{h}$ sliding. The smallest gap is 0. They are installed in the entire accuracy range of the mating sizes (5…12 qualities). They are often used for fixed joints with additional fastening if they need to be disassembled frequently (replaceable parts). In the qualifications 8…..12 can be used instead of transitional landings. Sliding landings are used for centering immovably connected parts. In movable joints, such landings serve for slow movements of parts, usually in the longitudinal direction; for precise direction in reciprocating motion; for connections of parts that should be easy to move and rotate relative to each other when setting, adjusting or tightening to the working position. Since obtaining zero gaps in such landings is unlikely, sliding landings can also be used for movable joints of rotational motion (at low rotational speeds).

Landing - $\frac{\mathrm{H}}{\mathrm{g}}$, $\frac{\mathrm{G}}{\mathrm{h}}$ - movement. These are the landings with the smallest minimum guaranteed clearance. They are installed at high relative accuracy of manufacturing parts (shafts – 4…6 quality, holes – 5….7 sq. m.).

Landings - $\frac{\mathrm{H}}{\mathrm{f}};\frac{\mathrm{F}}{\mathrm{h}}$ -way. They are characterized by moderate guaranteed clearances sufficient to ensure free rotation in sliding bearings. They are used in forward motion supports that do not require high centering accuracy.

Landings - $\frac{\mathrm{H}}{\mathrm{e}};\frac{\mathrm{E}}{\mathrm{h}}$ light footed. They have a significant guaranteed clearance, providing free rotational movement at significant loads and high speeds.

In fixed joints that require significant gaps during installations and adjustments.

Landings - $\frac{\mathrm{H}}{\mathrm{d}};\frac{\mathrm{D}}{\mathrm{h}}$ sharikohodovye. They have a large guaranteed gap, which allows compensating for significant deviations in the location of the mating surfaces and temperature deformations.

Landings - $\frac{\mathrm{H}}{a};\frac{\mathrm{H}}{b};\frac{\mathrm{H}}{c};\frac{A}{h};\frac{B}{h};\frac{C}{h}$ with large gaps.

Table 1.
Parameters entered into the program

D - nominal diameter of the hole, mm	ES - upper deviation of the hole, mm	EI - is the lower deviation of the hole, mm	d - nominal shaft diameter, mm	es - upper shaft deflection, mm	ei - lower shaft deflection, mm

Calculations performed by the program.

The largest maximum hole size, [mm] $D_{max} = D + ES$

Smallest maximum hole size, [mm] $D_{min} = D + EJ$

Hole size tolerance, [mm] $TD = D_{max} - D_{min}$

The largest maximum shaft size, [mm] $d_{max} = d + es$

Smallest maximum shaft size, [mm] $d_{min} = d + ei$

Shaft size tolerance, [mm] $Td = d_{max} - d_{min}$

The largest gap, [mm] $S_{max} = ES - ei$

Smallest gap, [mm] $S_{min} = EI - es$

Landing tolerance, [mm] $TS = S_{max} - S_{min}$

Landing tolerance, [mm] $TS = TD + Td$

Average clearance, [mm]

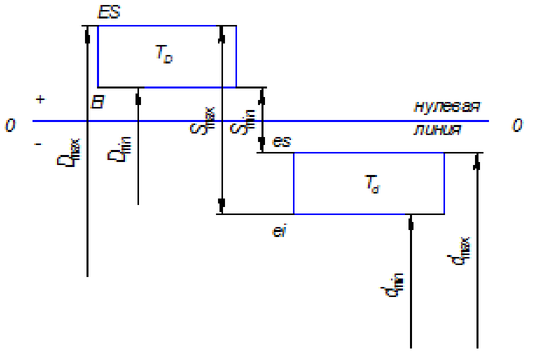

Fig.1. Layout of tolerance fields.

In the conditions of market relations in all industries, on the one hand, the issue of the quality of manufactured products has become acute, on the other hand, modern production cannot exist without its constant improvement and development. The basic basis for this is interchangeability at all levels of production. Therefore, the calculation of plantings is the basis for achieving a given accuracy of product quality.

When calculating landings with a gap, time is spent on mathematical calculations. In this regard, we automate the calculations: the largest limit hole size, the smallest limit size, the tolerance of the hole size, the largest limit shaft size, the smallest limit shaft size, shaft size tolerance, the largest gap, the smallest gap, landing tolerance, landing tolerance, average clearance.

Automation is the use of self-regulating technical means, mathematical methods and control systems that free a person from participation in the processes of obtaining, converting, materials or information, significantly reducing the degree of this participation or the complexity of the operations performed.

Application software consists of end-user programs. This is the most extensive class of software. Currently, applied software products have been developed and applied in most areas of human activity. Wherever large mathematical calculations are required, or large amounts of various data are processed, or a quick analysis of the situation with the adoption of a management decision is required, computers running application software successfully replace a person.

General-purpose application software is used to solve the most common informational tasks in any sphere of human activity. It combines widely used programs by most users of personal computers, for example, text editors, spreadsheets, graphics systems.

The program allows you to determine the system and type of landings, the maximum dimensions of shafts and holes for specified landings, landing parameters (maximum and minimum clearances), shaft tolerances, holes, and the construction of a landing scheme

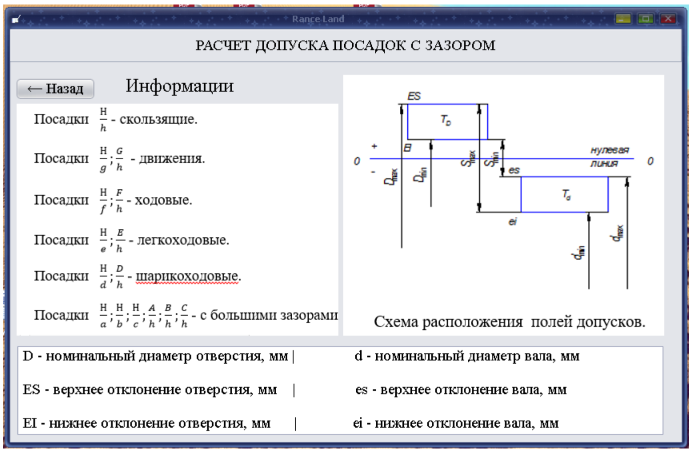

Fig. 2. Information about familiarization with the program.

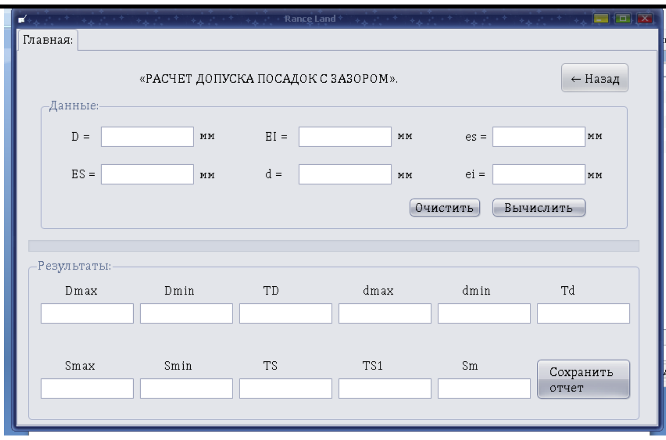

Fig.3. Data entry (bore and shaft diameters, reference data of upper and lower deviations).

The program "Clearance clearance calculation" is professional and available in the field of automation of clearance clearance calculation.

Computer type: - Windows:(7, 8, 10)

- Processor: Intel(R), Core:(3, 5, 7, 9)

Computer program volume in machine-readable form: 2.14 MB (2 248 704 bytes)

The program is registered by the Intellectual Property Agency.

Conclusion: This article discusses the calculations of landings with a gap using software. The advantage of automation is the reduction of time for calculating landings with a gap and the efficiency of working time. Elimination of errors in mathematical calculation and the use of settlement funds as an additional application. The program does not require additional knowledge when working on a computer. Reference data of the upper and lower deviations (reference books, tolerance software) are entered into the program.

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