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Minimizing the Consumption of Working Time when Machining the Connecting Rod by Optimizing the Machine Tool"

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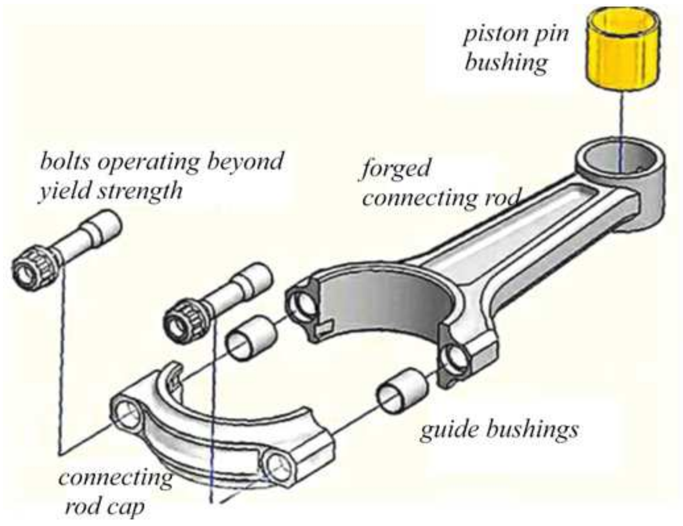
Annotation: This article contains general information about the connecting rods, its structure, methods of obtaining. Also, the calculation of the machine tool for milling the connecting rod flats was made.

Keywords: Connecting rod, rod, piston head, crank head, stamping, flats, fixture.

Connecting rods are a link of the connecting rod-crank mechanism and perform the transfer of force from the piston and convert its reciprocating motion into rotational motion of the engine crankshaft.

During operation, the connecting rods are subject to alternating workloads and inertia forces, due to this fact, the connecting rod must simultaneously have sufficient strength and rigidity, and have the smallest possible mass.

The main elements of the connecting rod are the rod, the upper piston head, the lower crank head.



That is, according to the drawing, you can see that the connecting rod is an assembly part, and its elements must have high accuracy.

Connecting rods are produced in two ways - stamping from high-strength steel or casting from cast iron. Diesel engines use connecting rods made of alloy steel by forging or hot stamping.

In some types of gasoline engines, connecting rods are installed that are made from powdered metals by sintering.

Particular attention is paid not only to the manufacture of connecting rods, but also to the fastening bolts. For the production of bolts, alloyed steels are used, which have a high yield coefficient, which is several times higher than that of high-carbon steels.

The connecting rods are checked after each operation and after complete processing. The diameters of the holes in the heads of the connecting rods are checked with limit plugs, gauges, indicator devices, pneumatic plugs.

The distance between the axes of the holes in the parts, deviations from parallelism, perpendicularity and the position of the axes of the holes are measured in the same way as in body parts.

One of the factors that increase the accuracy of a part is high-quality processing. High-quality processing can be achieved with the help of proper basing, and a strong installation on the machine tool. With each processing, the selection, calculation and design of the machine fixture is required. Consider such a part of the connecting rod as a flat, and calculate the device for milling the flats of the connecting rod.

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Machine fixture for milling flats. The device is used in milling operations. The device consists of a body, a support, a prism are attached to the body, and installation is carried out. The work piece is mounted on a support and a prism, clamped by a clamp.

According to the installation attached to the body, the working tool is configured to perform dimensions $10_{-0.4}$ и 20 ± 1. These dimensions are affected by the accuracy of the fixture.

We calculate the design of the selected device for accuracy

1) Size Accuracy Calculation 20 ± 1.

The accuracy of processing will correspond to the accuracy of the dimensions obtained in this operation, if the condition is met:

D J d=2

D – total processing error, mcm.;

d – processing size tolerance, mcm.

$$\Delta = \varepsilon + \Delta_H + \Delta_{ОБР},$$

e – installation error of the part in the fixture;

D adj – size adjustment errors;

D acc – processing method accuracy.

$$\varepsilon = \sqrt{\varepsilon_б^2 + \varepsilon_з^2 + \varepsilon_{пр}^2}$$

e b – basing error;

e c – clamping error;

e fix – fixture accuracy;

e b = 0, since the installation and technological bases are combined;
e cl = 0, because. the direction of the clamping forces is directed perpendicular to the size being performed.

e fix = $\sqrt{\left(\sum \delta_i\right)^2 + \delta_У^2 + \delta_И^2}$

- manufacturing errors of fixture parts $\sum \delta_i$ =0,03 (Determined by the perpendicularity of the installation surface and the side plane);
- fixture installation errors on the machine d У = 20 mcm.;
- tool parts wear errors due to lack of statistical data d w = 0.

e fix = $\sqrt{0{,}03^2 + 0{,}02^2 + 0^2} = 36$ mcm.

The total error of the installation of the part in the fixture:

$$\varepsilon = \sqrt{\varepsilon_б^2 + \varepsilon_з^2 + \varepsilon_{пр}^2} = \sqrt{0^2 + 0^2 + 0.036^2} = 36 мкм$$

$$\Delta H = \sqrt{(\Delta H_1^2 + \Delta H_2^2 + \Delta H_3^2)}$$

ΔH_2 =0,006 – at stylus thickness 0,5 мм;

ΔH_3 =0,02 – determined by setting the working cutter to the size of the installation using a feeler gauge;

$$\Delta H = \sqrt{0{,}4^2 + 0{,}006^2 + 0{,}02^2} = 0{,}04 мм$$

D tr= K2 * w

- K2 = 0,5 when performing sizes above the 7th grade;
- average economic accuracy of processing w = 160 mcm.

D tr = 0,5*160 = 80 mcm.

Total processing error:

$$\Delta = 36 + 40 + 80 = 156 мкм$$

The specified processing accuracy will be ensured, because D < d (156 mcm. < 2000 mcm.).

2) Size Accuracy Calculation $10_{-0.4}$.

The accuracy of processing will correspond to the accuracy of the dimensions obtained in this operation, if the condition is met:

D J d=0,4

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D – total processing error, mcm.;

d – machining tolerance, mcm.

$\Delta = \varepsilon + \Delta_H + \Delta_{OBP}$,

e – installation error of the part in the fixture;

D adj – size adjustment errors;

D pr – processing method accuracy.

$\varepsilon = \sqrt{\varepsilon_б^2 + \varepsilon_з^2 + \varepsilon_{пр}^2}$,

e b – basing error;

e cl – clamping error;

e fix – fixture accuracy;

e b = 0,06 mm – perforation on the ring in the set of cutters;
e f = 0, because. the direction of the clamping forces is directed perpendicular to the size being performed.

e f = $\sqrt{\left(\sum \delta_i\right)^2 + \delta_y^2 + \delta_и^2}$

- manufacturing errors of fixture parts $\sum \delta_i$ =0,03
- (Determined by the perpendicularity of the installation surface and the side plane); errors in the installation of the fixture on the machine d ins = 20 mcm.;
- wear errors of fixture parts due to lack of statistical data d w = 0.

e d = $\sqrt{0{,}03^2 + 0{,}02^2 + 0^2} = 36$ mcm.

The total error of the installation of the part in the fixture:

$\varepsilon = \sqrt{\varepsilon_б^2 + \varepsilon_з^2 + \varepsilon_{пр}^2} = \sqrt{0.06^2 + 0^2 + 0.036^2} = 70 мкм$

$\Delta H = \sqrt{(\Delta H_1^2 + \Delta H_2^2 + \Delta H_3^2)}$

ΔH_2 =0,006 – at stylus thickness 0,5 mm;

ΔH_3 =0,02 - it is determined by the adjustment of the cutter by the worker to the size according to the installation with the help of a probe;

$\Delta H = \sqrt{0{,}4^2 + 0{,}006^2 + 0{,}02^2} = 0{,}04 мм$

D tr = K2 * w

- K2 = 0,5 when performing sizes above the 7th grade;
- average economic accuracy of processing w = 160 mcm.

D tr = 0,5*160 = 80 mcm.

Total processing error: $\Delta = 70 + 40 + 80 = 190$ мкм.

The specified processing accuracy will be ensured, because D < d (190 mcm. < 400 mcm.).

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