

Research on Honing Technology of Valve Core Hole of Excavator Valve Body

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Abstract: This paper introduces the whole process flow of the valve core hole of excavator, and makes a deep study on the problem of the valve core hole size exceeding tolerance during the trial production, and finds the key factors that affect the quality of the valve core hole, by Means of tool adjustment and program improvement, the problem of machining valve core hole of excavator valve body is solved, and the qualified excavator valve body is manufactured successfully.

1. Introduction

With the rapid development of industrial technology, hydraulic control technology is more widely used in industrial production. Hydraulic machinery has the characteristics of high efficiency, high power and high precision, which makes the traditional heavy machinery gradually replaced by new hydraulic machinery. The promotion of hydraulic machinery mainly depends on the processing technology of the key parts of hydraulic parts. The processing accuracy of hydraulic valve holes directly affects the performance, life and use of products, and the improvement of the processing technology of high-end hydraulic assembly components has become the top priority.

The excavator valve body is a high-end hydraulic product used for construction machinery, mainly used for the excavator control powertrain, is the "heart" of the excavator control system. The valve body is a kind of automatic component with hydraulic oil as the operating medium, which is combined with all kinds of hydraulic valve and valve core. Through the action of the hydraulic valve body, it controls the direction, break, flow, pressure and other parameters of the oil medium, and indirectly controls the action of each joint of the excavator. In the processing of each valve hole of the valve body, the size accuracy, geometric accuracy and surface roughness of the valve core hole are the most strict, which is the difficult part of the valve body processing and the core of the valve body structure. As shown in Figure 1.

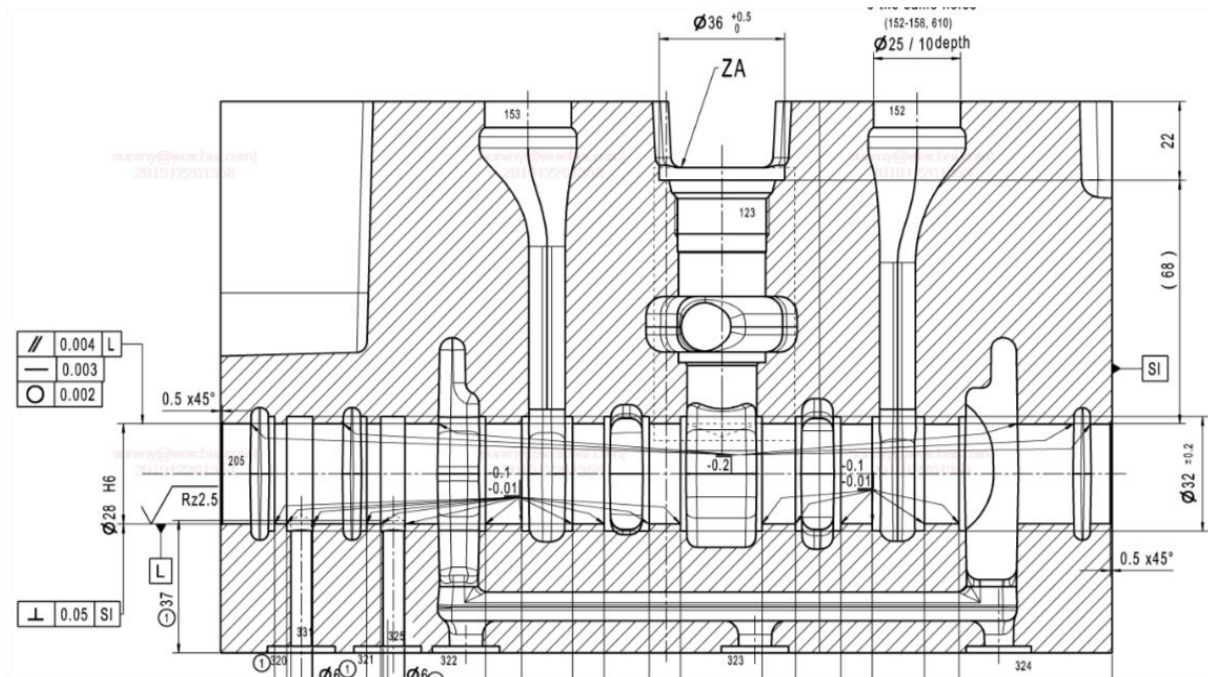


Figure 1 Structure diagram of the valve core hole

2. Sool hole processing process

The body material is creep cast iron, the core hole diameter is D28H 6, the hole wall roughness is Rz 2.5, the upper limit of roundness is 0.002mm, the upper limit of straightness is 0.003mm, the upper limit of parallelism is 0.004mm, the precision coordination between the core and the core, so the processing requirement of the core hole is very high. The processing process of valve core hole adopts the processing sequence of expansion-hinge-honver^[4], Specifically divided into coarse expansion, half fine expansion, half fine pre-hinge, half fine hinge, fine hinge, fine hinge, wire brush burr, heat explosion to burr, rough hang, rough hang, half fine hang, fine hang, carbon silicon brush burr and other steps, finally ensure the processing quality of the valve core hole^[1].

3. Trial production problem

During the test of the valve body of the valve excavator. After the core diameter size and shape tolerance, bore diameter size and shape tolerance, core hole roughness, testing equipment accuracy item by item, the problem is locked on the core hole processing, and the actual measurement bore roughness meet the requirements of Rz 2.5, but circle, straightness, parallel shape tolerance poor, analyzed in this case, adopted a series of measures to improve the quality of core hole processing, to ensure the valve body qualified offline.

4. Analysis and improvement of influencing factors of valve core hole quality

4.1 Analysis of reinger processing situation

After the reaming process, the straightness of the valve hole can be effectively controlled. At this time, the main purpose of selecting the guide single-blade precision reamer to handle the valve hole is to correct the roundness error of the hole. According to the processing of the hinger, it was found that the beating value of the hinger in the processing center is large, and the actual measurement of

the beating of the four hingers with the instrument, and the maximum beating value reached 0.08mm. After communication with the tool manufacturer, the beating of the hinger needs to be adjusted to within 0.03mm. In view of this situation, we adjusted the hinger in the machining center to ensure that the tool beating is running within 0.02mm, and on this basis, the reaming of the valve body core hole. The final result shows that the arrounding of the hinghole can reach 0.01~0.025mm, but the straightness and parallelism are 0.02~0.05mm, which requires further correction in the honing process. The test results are shown in Figure Figure 2 and Figure Figure 3

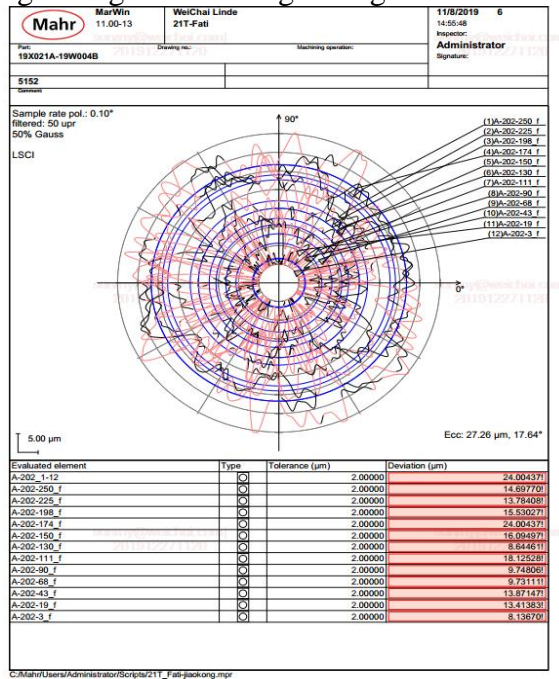


Figure 2 Rdness after the ingaming

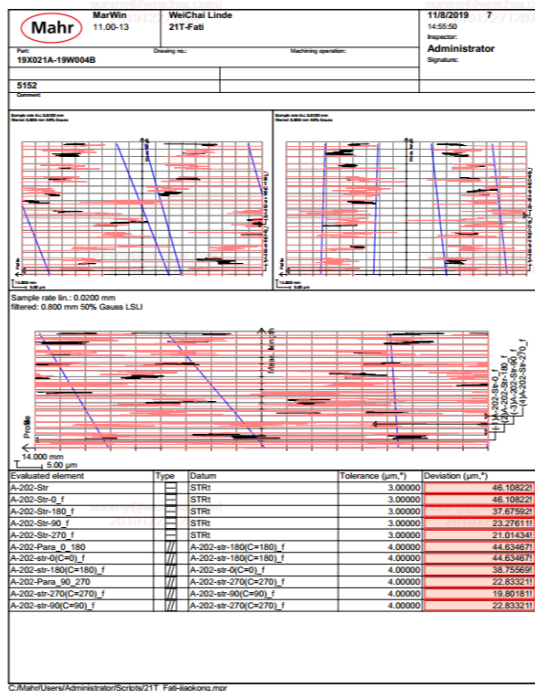


Figure 3 Straightness and parallelism after the hinge

4.2 Honing processing allowance and rising honing processing pressure and frequency

The function of honing process is to correct the roundness, straightness and surface roughness. The highest ability of honing processing to correct the circular degree is up to ten times, that is, if the cylindrical degree of honing is 0.03mm, the cylindrical degree of honing can reach 0.003mm. Under the condition of effectively ensuring the accuracy of the previous process, the cylindrical degree of the rear honing valve hole can reach 0.0015~0.003 mm, and the surface roughness can reach Rz 2.5, which better meets the design requirements.

Although honing can remove a large processing allowance, too large allowance will affect the processing efficiency and processing quality; too small allowance will produce poor honing quality or even shock knife phenomenon. In order to remove the surface processing traces and shape errors of the previous process, the processing allowance should be greater than the total error of the previous process (including shape error and surface roughness). According to the field tool situation and manufacturer guidance, the final tool processing allowance is: rough plover (0.01mm), half fine plover (0.007mm), and fine plover (0.003mm).

The processing principle of the honing knife is: the internal cold pressure presses the honing strip on the hole wall, and the honing is repeatedly conducted in and out to remove the margin. So the honing margin of the honing knife is determined by the honing pressure and the honing times. In general, the higher the honing pressure, the higher the processing efficiency, but it also will lead to poor honing surface quality. The cold pressure in the existing honer is stable at 20bar, and the honing size is adjusted by changing the processing times. The plover mainly corrects the straightness of the hole system. The straightness of the core hole after the plover processing can reach 0.003~0.005mm, and the roundness also needs the correction of the later order tool.

4.3 Length of honstrip and circle

The length of honing strip mainly depends on the length of honing hole. It is designed and manufactured by the tool manufacturer after studying the actual length and working condition, and belongs to the special tool of the valve body core hole. The length of honing strip is 120mm, the middle part of 60mm is the main honing part, and the diameter of honing strip at both ends is decreasing. The valve body core hole has multiple gear grooves, and the honing knife is in a continuous cutting state. When the length of the honing bar is too short, the tool guide is poor, the honing efficiency is low, and when the honing bar is too long, it is easy to make the hole drum shape, which affects the cylindrical degree of the hole^[5].

The grinding strip will be installed on the honing head before leaving the factory, and rounded on the grinder. After the round, the maximum cylindrical degree of the grinding strip shall not exceed 0.01mm. Due to the honing tool, the front and rear ends of the honing strip must be chamfer treatment to reduce the resistance in the process of tool advance and retreat, increase the stability of the tool, and prevent the phenomenon of shock tool.

4.4 Honing stroke and crossing volume

In order to process the hole system with consistent diameter and good roundness, the length, honing stroke and crossing range (both ends) must be reasonably selected. The crossing amount of honing is the length protruding from the exit and the length left by the honing tool, which must ensure that the midpoint of the honing section is located at the exit and entry hole. If the range volume is small, there will be "horn mouth" phenomenon at the outlet, that is, the diameter of the outlet position is smaller; if the overall range volume is large, the support area of the tool at the inlet and exit will be less, and the tool will show an unstable state with slight shock knife and beep^[2].

4.5 Impact of burr removal

The holes inevitably have burrs, which may affect the honing quality of the core holes. The valve body adopts the combination of brush deburr and heat energy explosion deburring to eliminate the burr. The core hole excavator has a very small chamfer, which is mainly used to remove the burrs from the groove; thermal energy deburr adopts the method of gas combustion to vaporize the small burr to remove the burrs; after the reaming process, remove the burr from the core hole; after honing, remove the burrs from honing with carbon-silicon brush. The removal of burr in each process ensures the processing quality of the spool and the smooth movement of the valve core in the valve body, and prevents the occurrence of valve jamming phenomenon.

After a series of adjustments and improvements, the roundness, linearity, parallelism and other dimensions of the valve core hole meet the requirements of the drawings, the leakage at the valve body core hole is reduced to within the qualified range, and each hydraulic valve is running normally. Results are shown in Figure 4 Figure 5.

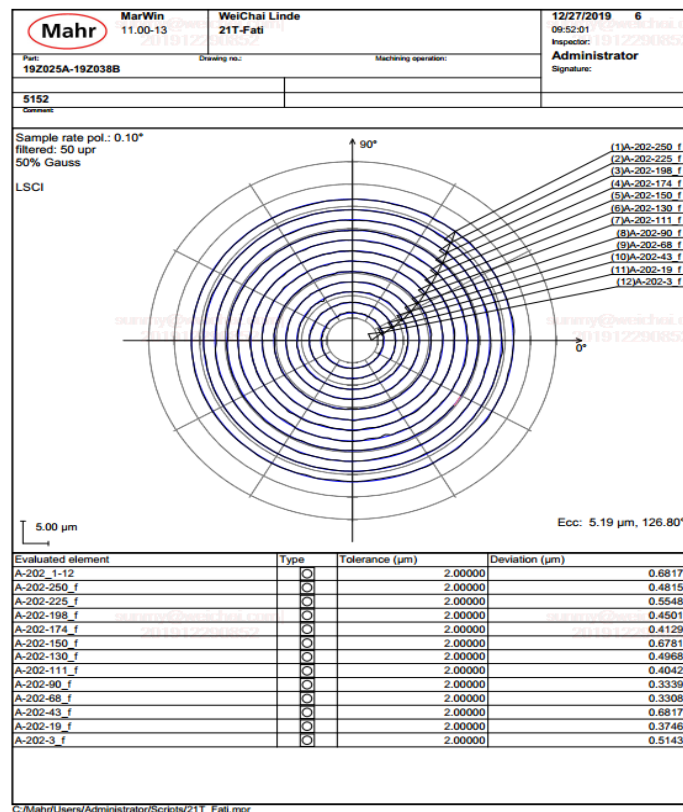


Figure 4 Rilarity after honing

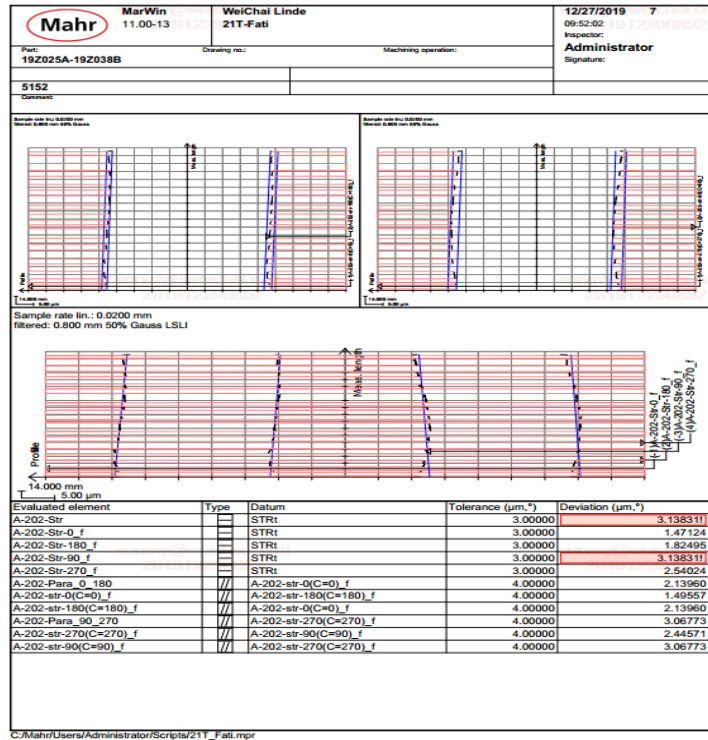


Figure 5 Straightness and parallelism after honing

5. Conclusion

The valve body is the key part of the excavator powertrain. The processing quality of the valve body directly affects the leakage capacity, action and reliability of the valve body. In this paper, through the study of the tools and parameters closely related to the processing quality of the core hole, we found a series of factors to ensure the quality assurance of the core hole, ensured the processing quality of the excavator valve body, realized the established goal of qualified leakage quantity, and accumulated experience for the subsequent development of hydraulic products^[3].

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